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THESIS

MODERNIZATION THROUGH SPARES FOR THE ARMY'S LIGHT TACTICAL VEHICLE

by

Daryl P. Harger

December 2000

Thesis Advisor: Brad Naegle

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In recent years, the Department of the Army has responded to the Federal Acquisition Streamlining Act of 1994 (FASA) and the Federal Acquisition Reform Act of 1996 (FARA) by implementing several policies and procedures. The policies are designed to cope with the challenge to operate with an ever-shrinking Defense budget and yet provide our warfighters with the weapon systems they need to succeed. One of the strategies employed by the Army to this end is Modernization Through Spares (MTS).

In a 22 January 1996 memorandum sent out by then Assistant Secretary of the Army (Research, Development and Acquisition), Gilbert F. Decker expressed his wishes to test the MTS concept on several programs, including the High Mobility Multi-purpose Wheeled Vehicle (HMMWV). He illustrated the MTS concept through an example, "While the old strategy may have gotten us a good price on a vacuum tube, for example it is time to begin buying semi-conductor chips with dramatic reductions in life-cycle costs and dramatic improvements in performance and reliability."

This research will analyze how the Program Manager (PM) of Light Tactical Vehicles (LTV) of the U.S. Army Materiel Command (AMC) implements Modernization Through Spares (MTS) for their HMMWV program. The objective is to establish the extent to which PM-LTV implements MTS and identify the methods used for MTS implementation in order to comply with the Army's strategy for MTS.

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MODERNIZATION THROUGH SPARES FOR THE ARMY'S LIGHT TACTICAL VEHICLE

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Submitted in partial fulfillment of the
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ABSTRACT

In recent years, the Department of the Army has responded to the Federal Acquisition Streamlining Act of 1994 (FASA) and the Federal Acquisition Reform Act of 1996 (FARA) by implementing several policies and procedures. The policies are designed to cope with the challenge to operate with an ever-shrinking Defense budget and yet provide our warfighters with the weapon systems they need to succeed. One of the strategies employed by the Army to this end is Modernization Through Spares (MTS).

In a 22 January 1996 memorandum sent out by then Assistant Secretary of the Army (Research, Development and Acquisition), Gilbert F. Decker expressed his wishes to test the MTS concept on several programs, including the High Mobility Multi-purpose Wheeled Vehicle (HMMWV). He illustrated the MTS concept through an example, "While the old strategy may have gotten us a good price on a vacuum tube, for example it is time to begin buying semi-conductor chips with dramatic reductions in life-cycle costs and dramatic improvements in performance and reliability."

This research will analyze how the Program Manager (PM) of Light Tactical Vehicles (LTV) of the U.S. Army Materiel Command (AMC) implements Modernization Through Spares (MTS) for their HMMWV program. The objective is to establish the extent to which PM-LTV implements MTS and identify the methods used for MTS implementation in order to comply with the Army's strategy for MTS.

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I. INTRODUCTION

A. AREA OF RESEARCH

This research will analyze how the program office of Light Tactical Vehicles (LTV) of the U.S. Army Materiel Command (AMC) implements Modernization Through Spares (MTS) for their High Mobility Multi-purpose Wheeled Vehicle (HMMWV) program. The objective is to establish the extent to which PM-LTV implements MTS and identify the methods used for MTS implementation in order to comply with the Army's strategy for MTS (as indicated in then acting Assistant Secretary of the Army for Research Development and Acquisition, the Honorable Kenneth J. Oscar's 12 Jan 98 memorandum).

B. RESEARCH QUESTIONS

The primary research question is: How does the PM-LTV implement MTS to comply with the Army's strategy for MTS? Secondary research questions include:

- Does the method used by PM-LTV to implement MTS differ from the Army's implementation strategy?
- What are the objectives, advantages, and disadvantages of MTS?
- Do any methods employed by PM-LTV reduce or eliminate the advantages of MTS?
- What challenges does PM-LTV face in implementing MTS?

C. BACKGROUND

In recent years, the Department of the Army has responded to the Federal Acquisition Streamlining Act of 1994 (FASA) and the Federal Acquisition Reform Act of 1996 (FARA) by implementing several policies and procedures. The policies are designed to cope with the challenge to operate with an ever-shrinking Defense budget and yet provide our warfighters with the weapon systems they need to succeed. One of the strategies employed by the Army to this end is Modernization Through Spares (MTS).

In a 22 January 1996 memorandum sent out by then Assistant Secretary of the Army (Research, Development and Acquisition), Gilbert F. Decker expressed his wishes to test the MTS concept on several programs, including the HMMWV. He illustrated the MTS concept through an example, "While the old strategy may have gotten us a good price on a vacuum tube, for example it is time to begin buying semi-conductor chips with dramatic reductions in life-cycle costs and dramatic improvements in performance and reliability." [Ref. 1]

A later memorandum dated 18 June 1997 sent out by then Acting Assistant Secretary of the Army Kenneth J. Oscar, reflected some of the initial progress the Army had accomplished on MTS. The memorandum reported the success achieved during an Army conference on MTS (May 28-29, 1997) which revealed the potential is staggering to:

- Reduce long-term sustainability costs (O&S), which consume at least 60 percent of a system's life cycle costs
- Upgrade system capability

- Introduce new technology which significantly improves reliability
- Integrate the military and commercial industrial bases

Mr. Oscar also used the memorandum to direct the establishment of an Overarching Integrated Process Team (OIPT) to "advise, assist and monitor implementation of MTS across the Army." [Ref. 2]

Figure 1 represents the key events preceding the development of the Army Strategy for Modernization Through Spares. A series of Department of the Army memorandums emphasized the importance and potential benefits associated with MTS. An MTS workshop in May 1997 laid the foundation for MTS and kept momentum moving forward for the eventual implementation. Finally, the MTS OIPT published the Army Strategy for the Implementation of MTS in early 1998.

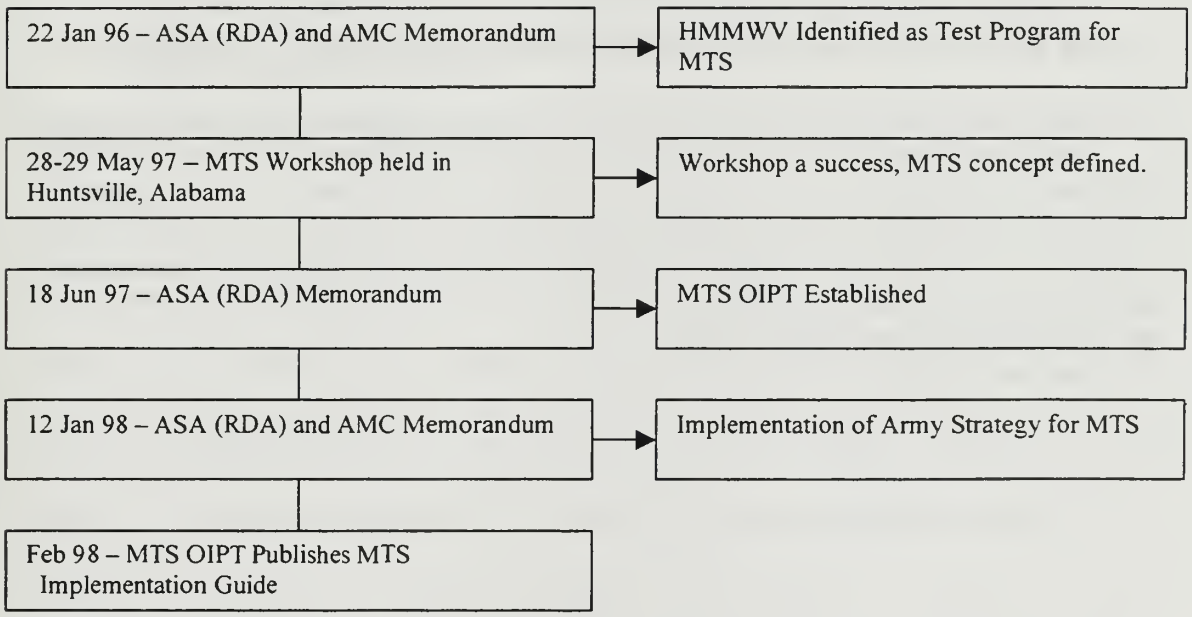
22 Jan 96 – ASA (RDA) and AMC Memorandum
HMMWV Identified as Test Program for MTS
28-29 May 97 – MTS Workshop held in Huntsville, Alabama
Workshop a success, MTS concept defined.
18 Jun 97 – ASA (RDA) Memorandum
MTS OIPT Established
12 Jan 98 – ASA (RDA) and AMC Memorandum
Implementation of Army Strategy for MTS
Feb 98 – MTS OIPT Publishes MTS Implementation Guide

Figure 1. Key Events for Army MTS [From Data Compiled by Author]

The Army spends billions of dollars annually on spare parts. However, the majority of these spare parts are simply replacements for existing parts without changing the design or reliability of the part. [Ref. 1] MTS modernizes existing systems through replacing spare parts with superior spares, during routine sparing and maintenance actions.

D. SCOPE OF RESEARCH

The research will begin with a review of the literature to determine the definition, objectives, advantages, and disadvantages of MTS. Next, an examination of the implementation of MTS at the U.S. Army Materiel Command (AMC) will be conducted to form the basis of how MTS should be implemented within the Light Tactical Vehicle (LTV) program office. The acquisition strategy developed by the LTV program office for their High Mobility Multi-purpose Wheeled Vehicle (HMMWV) in support of MTS will then be reviewed to discern how the LTV program office supports MTS to comply with the ASA (RDA) and AMC Memorandum 22 January 1996 memorandum. Conclusions will be drawn from the analysis and will be followed by recommendations and suggested areas for further research.

II. MODERNIZATION THROUGH SPARES

A. DEFINITION OF MODERNIZATION THROUGH SPARES

The Under Secretary of Defense (Acquisition, Technology and Logistics) (USD (ATL)), Dr. J.S. Gansler, defines Department of Defense Total Ownership Costs (DoD TOC) as, "...the sum of all financial resources necessary to organize, equip, train, sustain, and operate military forces ...." and "...is comprised of costs to research, develop, acquire, own, operate, and dispose of weapon and support systems...." [Ref. 3] Life Cycle Costs (LCC) are a subset of DoD TOC and include acquisition program direct costs plus the indirect costs attributable to the acquisition program such as depot maintenance, contractor support, and mission personnel, among others. [Ref. 4]

Headquarters, U.S. Army Materiel Command (AMC) defines MTS as

> ...a spares acquisition strategy applied throughout the materiel acquisition lifecycle to reduce sustainment costs. It is based on technology insertion and use of commercial products, processes, and practices to extend a system's useful life. [Ref. 5]

Similarly, the MTS Overarching Integrated Process Team (OIPT) defines MTS as "a spares/component improvement strategy applied throughout the Acquisition Life Cycle and is based on technology insertion to enhance systems and extend useful life while reducing costs." [Ref. 6] The primary focus, then, of MTS is to improve the particular component while reducing the total life cycle cost of the system. Instead of the old practice of purchasing the same part or component that was originally designed for the component, subsystem, or system, emphasis now is placed on using the latest technological advances when replacing the component to renew the Army's equipment.

The concept of MTS is to modernize existing systems achieved through routine sparing and maintenance actions. In order to accomplish the modernization, the replacement spare must replicate the Form, Fit, and Function (F^3) of the replaced part. Additionally, technical procedures currently used in the field are not to be altered. Lastly, the modernized part or subsystem cannot alter or otherwise affect any Configuration Item (CI). [Ref. 7]

Spare parts management is important because it costs money to maintain inventory and ultimately affects readiness. The money tied up maintaining huge stockpiles of spare parts could be used for other pressing priorities. However, the solution isn't to simply get rid of those stockpiles of inventory, but to better manage the resources we have to achieve the desired level of readiness and reduce the total cost of operating the system (the life cycle costs).

Modernization through spares affects the life cycle cost of systems by improving the reliability of the component. Subsequently, the reliability of the component reduces life cycle costs by reducing the frequency of maintenance for the system and requiring fewer inventories to be managed. Generally speaking, as the reliability of a system increases, the frequency of corrective maintenance required on the system decreases. [Ref. 8] This makes sense intuitively because as the component reliability improves, the component does not fail as often and therefore does not need to be repaired as often. Since the component fails less often, you need new replacement parts less often, which means you do not need to maintain the same level of spare parts.

Department of the Army (DA) Pamphlet (Pam) 70-3 includes MTS as a type of modification. A modification is "...the alteration, conversion, or modernization of an

end item that changes or improves the original purpose or operational capacity in relation to effectiveness, efficiency, reliability or safety of that item." [Ref. 27] Other modification efforts include Service Life Extension Program (SLEP), Pre-Planned Product Improvement (P3I), and block upgrades. The method to accept the modification on configuration items already in the Army inventory is the Modification Work Order (MWO). [Ref. 27] It is useful to define the above terms to differentiate which *modification* initiatives can also be classified as a *modernization* effort.

The Defense Systems Management College (DSMC) defines SLEP as "modification(s) to fielded systems undertaken to extend the life of the system beyond what was previously planned." [Ref. 26] This modification may or may not include a modernization initiative. Perhaps the same operational characteristics are maintained using "then technology" and only the service-life years are extended.

The DSMC and DA Pam 70-3 provide nearly identical definitions of P3I (the DSMC version is provided with DA Pam 70-3 deviations in brackets). A P3I "is a planned future [evolutionary] improvement of developmental systems for which design considerations are effected [accomplished] during development to enhance future application of projected technology. Includes improvements planned for ongoing systems that go beyond the current performance envelope to achieve a needed operational capability." This clearly represents a modernization effort.

A block modification (upgrade) is "...a grouping of modifications for the purpose of achieving economies in funds, manpower, equipment and/or time to enhance configuration management. A block modification includes several modifications in engineering, procurement and/or application that are managed as a single modification."

[Ref. 27] This modification method could be classified as a modernization effort if that grouping of modifications inserted current technologies that enhanced the performance or operational effectiveness of the system or component.

Given the above definitions, the terms MTS, SLEP, block modifications, and P3I are all modifications. However, MTS and P3I are modernization efforts whereas SLEP and block modifications may or may not be classified as modernization initiatives. The MWO is the formal method to process modifications to configuration items once those items are in the Army inventory.

B. ADVANTAGES AND DISADVANTAGES OF MTS

Several advantages and disadvantages prevail through the utilization of an MTS process. Advantages include improved reliability, maintainability, and supportability; reduction of life cycle costs; infusion of current technology; and supporting DoD and US Army goals, initiatives, and directives. Disadvantages include possible compatibility/interoperability problems; increased supply chain management resource use; data collection; high up-front costs; and MTS competing with projects with immediate or near-term payoffs. The following sections describe the advantages and disadvantages of MTS in greater detail.

1. Advantages of MTS

One benefit of MTS is that the entire fleet does not need to be retrofitted at once. As components approach or reach their designed failure point, the component can be replaced with the modernized part during routine or expected maintenance intervals. Of course, the upgraded component can also be installed as part of any corrective

maintenance action as well. The components currently installed on the system or subsystems are fully exploited until they reach failure or scheduled replacement, achieving maximum utilization of existing parts. [Ref. 7]

Another benefit of MTS realized from implementation through natural attrition is that training time is not disrupted due to mass fleet upgrades. Systems are available as long as they are operational and components only upgraded when the component fails or is ordinarily scheduled for replacement.

The MTS Overarching Integrated Process Team identified many benefits of MTS as shown in Table 1. Most of the benefits relate to the relationship between the contractor and Government (e.g., share risk, share savings, award cost avoidance). A few benefits stem from reducing overall lifecycle costs or leveraging the availability of funds while the remaining benefits are attributed to improving the system's performance, reliability, or maintainability.

Benefits of MTS	
Leverage Spares Procurement	*Modernization through Overhaul*
Reduce Cost of Ownership	*Change for Commercial Technology*
Attrition vs. Forced Retrofit	*Share Risk*
Incentivize Industry	*Enhance Performance*
Team with Industry	*Reduce O&S Costs*
Increase Technology Insertion	*Prolong Life*
Award Cost Avoidance	*Share Savings*
Enhance Availability	*Performance Based Procurement*
Replace Obsolete Parts	

Table 1. Benefits of Modernization Through Spares [After Ref. 6]

Modernization through spares supports the intent of the Assistant Secretary of the Army (Acquisition, Logistics, and Technology) (ASA (ALT)), formerly the ASA

(Research, Development and Acquisition) (ASA (RDA)). He established Operating and Support (O&S) cost reduction as an acquisition priority by issuing a memorandum on 29 April 1997. [Ref. 9] Later, he directed the acquisition community to implement further guidance on Total Ownership Cost Reduction (TOCR) contained in a follow-on memorandum. [Ref. 10] In a memorandum dated 18 June 1997, the former ASA (RDA) highlighted the potential benefits of MTS to

- Reduce long-term sustainability costs (O&S), which consume at least 60 percent of a system's life cycle costs
- Upgrade system capability
- Introduce new technology which significantly improves reliability
- Integrate the military and commercial industrial bases

[Ref. 2]

Several examples exist of organizations reaping the benefits of MTS. Although successful application of MTS is prevalent in the Defense sector, the commercial industry has also realized benefits from focused spare parts management.

In 1991, ITT Industries Aerospace/Communications Division located in Fort Wayne, Indiana formed a team to deal with several problems the company was experiencing with their customers. They had a low on-time delivery performance (50 to 60 percent) for spares and repairs, no system for tracking or prioritizing spares orders, and numerous complaints from their customers. The newly formed team was essentially an integrated process team with members from the Logistics, Manufacturing, and Contracts departments. They were able to address the concerns of the company; achieve an increase in their on-time delivery performance to 99 percent; and reduce their bids and proposals costs by 25 percent. Their improved performance resulted in increased

customer satisfaction and an increase in the company's sales revenue in Spares, Repairs, and Support from $4 million to nearly $25 million. [Ref. 11]

The U.S. Army Communications – Electronics Command (CECOM) has benefited extensively through the use of MTS. They have used Commercial off the Shelf (COTS) components and the MTS approach to enhance the reliability of the Frequency Multiplier Oscillator (FMO). The program has achieved an increase in reliability of 20 percent and enjoyed benefits such as reduced complexity (reduces procurement and repair activity), reduced repair costs, and increased availability. Estimated net savings for remaining life cycle costs are approximately $2.2 million. [Ref. 12]

Another program managed by CECOM successfully implementing MTS is the User Readout (URO) for the Enhanced Position Location Reporting System (EPLRS). Their weapon system IPT together with standardization specialists used performance specifications to reduce a detailed 76-page specification down to a 12-page F^3 performance specification. They were able to achieve cost reductions for production of $4,000 per unit (it costs less than $1,000 to build now) and are now able to build it for less than the previous contract to replace obsolete parts! [Ref. 12]

The U.S. Army Aviation and Missile Command (AMCOM) is also using MTS for a component of their Patriot Missile System. The Solid State Data Storage (SSDS) for Patriot missiles is replacing the old Optical Drive Unit (ODU) used to upload mission critical software for the operation of the weapon system. The upgrade will be accomplished through an attrition-based strategy utilizing readily available commercial parts. Reliability of the SSDS is much greater than the ODU and is expected to exceed

the life of the system. Over the five-year period beginning in 1999, O&S cost savings are estimated to be $81 million. [Ref. 13]

2. Disadvantages of MTS

Though there are many advantages achieved from MTS, it is imperative to consider the disadvantages as well. Because MTS uses replacement through attrition, it is possible for two different part numbers to be in existence for the same part in the supply system causing confusion among maintenance and supply personnel. Component replacement problems may arise from the confusion causing delays and increasing the administrative delay time. Interoperability and compatibility issues may arise due to more than one version of the repair part being available at a given time. [Ref. 7]

Data collected on the modernized component or system may be difficult or impossible to determine or obtain. Since modernization occurs through attrition, the configuration of the fleet will be a mix of old and new components, which adds a burden to the logisticians responsible for supporting the system. Even a robust information tracking system would find it difficult to compile failure data on the modernized part or subsystem with mixed configurations present. [Ref. 7]

When program managers and field commanders are faced with selecting a project that would reduce operating and support costs (over the long-run) or a project that improves safety, availability, or readiness (in the near-term), the project offering near-term benefits often wins. In an August 2000 General Accounting Office (GAO) report on Defense Acquisitions, it was reported that most operating and support cost reduction efforts require a heavy up-front investment that may take years to pay back. "This slow pay-back, and the many uncertainties that accompany improvement projects, make it

difficult for the initiatives to compete against investments that provide near-term improvements in safety, availability, or combat capability." [Ref. 14]

C. IMPLEMENTATION OF MTS BY THE ARMY MATERIEL COMMAND

The Honorable Kenneth J. Oscar, as acting ASA (RD&A), formed an Overarching Integrated Process Team (OIPT) for MTS on June 18, 1997 to formalize the MTS process, provide assistance, and monitor implementation. [Ref. 2] In a subsequent memorandum published January 12, 1998, the acting ASA (RD&A), together with the commander of US Army Materiel Command, General Johnnie E. Wilson, formalized the implementation of the Army strategy for MTS. [Ref. 15]

In accordance with the acting ASA (RD&A) guidance, the MTS OIPT published a guide, "Army Strategy for Modernization Through Spares" to assist all Army managers who develop systems or buy spares. [Ref. 6] The guide suggests the MTS approach can be applied to any weapon system in any life cycle phase but made a distinction between the outputs of a program in one of the Pre-Milestone III phases and a program in the Post-Milestone III phase. The MTS process is essentially the same; only the focus and outputs are different. A program in one of the Pre-Milestone III phases implementing the MTS process should focus on how modernization will be achieved throughout the system's life cycle. In other words, the focus should be on "designing for modernization." [Ref. 16] For programs in the Production, Fielding/Deployment, and Operational Support Phase (Post-Milestone III), emphasis is on the use of performance specifications to enhance the design baseline. [Ref. 6]

The OIPT identified five key elements of the MTS approach: The Integrated Process Team (IPT); Related Efforts; Inputs; Key Functions; and Outputs. Figure 2 depicts the relationship among the key elements.

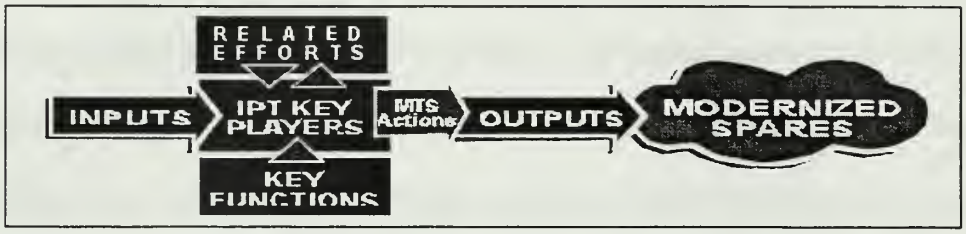

Figure 2. Key Elements of the MTS Approach [From Ref. 6]

The starting point for the MTS process is the formation of the Integrated Process Team (IPT). Participants of the IPT should include professionals from each of the acquisition functional areas listed in Table 2. Additional participants may include stakeholders from the user, contractor, and industry.

Acquisition Functions	
Acquisition Management	*System Engineering*
Software Acquisition Management	*Test and Evaluation*
Manufacturing and Production	*Acquisition Logistics*
Business Cost Estimates and Financial Management	*Contract Management*

Table 2. Acquisition Program Planning and Management Functions [After Ref. 6]

The IPT evaluates each candidate component of a system or subsystem that has been identified for modernization. The proposed components are either currently limiting the operational capability of an existing system or have the potential to degrade the operational capability or readiness of the system in the future. The evaluation focuses on the candidate's potential to improve the readiness or performance of the system in areas

such as enhanced availability, reduced cost of ownership, and enhanced system capability. [Ref. 16]

The guide provides two types of data that must be considered for MTS candidates – proactive and reactive type data. Proactive data include analysis of future system needs, diminishing manufacturing capabilities, and lower cost opportunities, for example. Reactive type data stem from maintenance, availability, and cost of ownership statistics such as mean corrective maintenance time, mission capability rates, and depot maintenance cost. [Ref. 6] Figure 3 identifies the underlying variables that makeup the key factors of the MTS process. The related efforts in Figure 3 and the MTS initiative complement each other. Related efforts are programs and processes such as Value Engineering (VE); Cost as an Independent Variable (CAIV); Reliability, Maintainability, and Supportability (RMS); and Operational Support Cost Reduction (OSCR). Outputs of the MTS approach can be grouped into pre- and post-milestone III categories. Pre-milestone III outputs influence the acquisition strategy and Logistics Support (LS) plan. Modernization Through Spares is supported through the use of such concepts as performance specifications, open system designs, and CAIV principles in the design of spares. These concepts are reflected in the solicitation document in an attempt to attract the best technical solution to meet the program's requirements. [Ref. 6]

Post-milestone III outputs address the evaluation of existing components for possible redesign. Degraded performance, obsolescence and emerging technologies are the driving forces behind the MTS approach at this stage in the program's life cycle. The components and logistics processes are analyzed to determine feasible and cost effective solutions to achieve the objectives of MTS. A noteworthy difference between pre- and

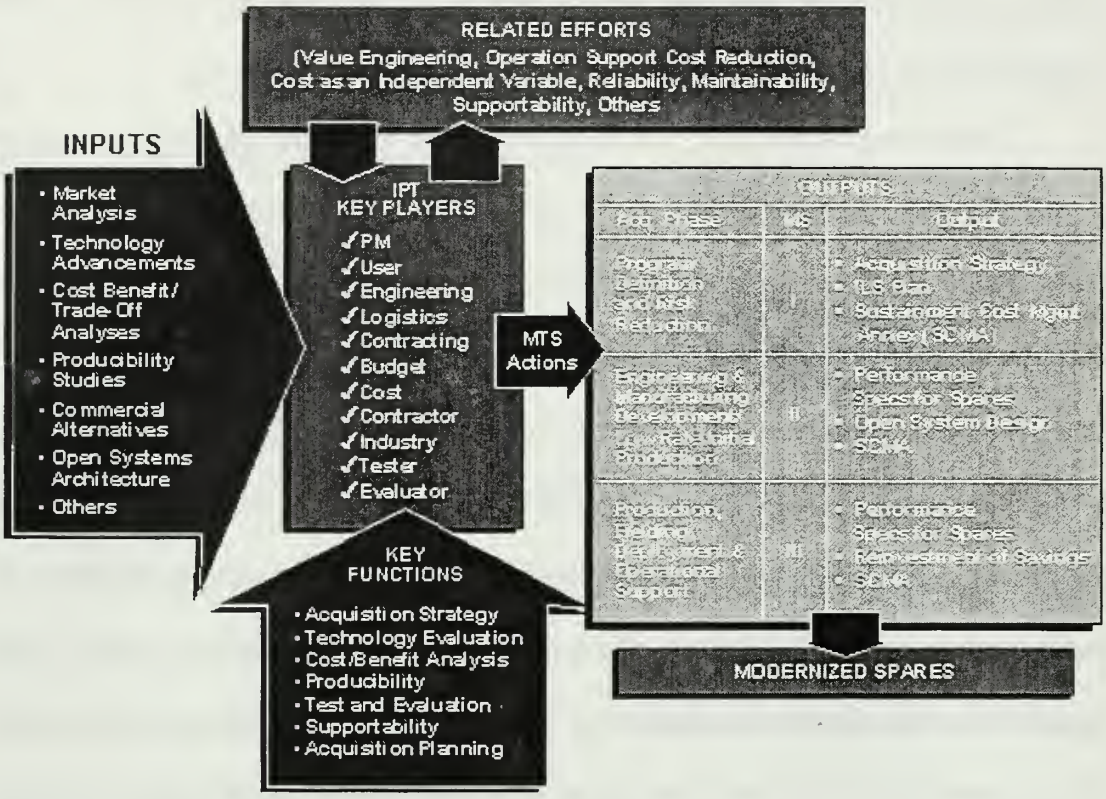

Figure 3. The MTS Process [From Ref. 5]

post-milestone III MTS considerations is that the potential savings are long-term for pre-milestone III programs whereas the savings are generally near-term for programs past the milestone III point. [Ref. 16]

D. CHAPTER SUMMARY

Modernization Through Spares is an initiative that supports the acquisition priority set forth by the Assistant Secretary of the Army (Acquisition, Logistics, and Technology) (ASA (ALT)) to reduce Operating and Support (O&S) costs. Benefits of MTS include technology insertion, enhanced performance and availability, and reduction

of total ownership costs. Disadvantages of MTS are heavy initial investments, compatibility and interoperability challenges, and data collection, among others.

The Overarching Integrated Process Team (OIPT) for MTS published a guidebook to assist Army managers who develop systems or buy spares. The OIPT also developed a process to implement MTS that is useful in both Pre-Milestone III programs and Post-Milestone III programs. The most important factor in the MTS process is the use of an Integrated Process Team (IPT) approach with members from each of the functional areas of acquisition and stakeholders from the user (buying activity), industry, and contractor communities.

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III. THE HMMWV AND PM-LTV

A. BACKGROUND AND HISTORY

The AM General Corporation, manufacturer of the HMMWV, has a long history of producing tactical vehicles for the Armed Forces. The AM General Corporation and its "ancestors" began manufacturing military trucks as early as the 1940s with the production contract for the "Jeep". Since then, they have produced several configurations and varieties of ¼-ton, 2 ½-ton, and 5-ton tactical trucks as well as some 14- to 20-ton truck series varieties, as depicted in Figure 4.

The High Mobility Multi-purpose Wheeled Vehicle program started in 1979 when AM General began preliminary design work on a 1-ton truck intended to replace the M151 series vehicles (Jeeps) and other light tactical vehicles. AM General was awarded a competitive prototype contract for its new light tactical vehicle from the U.S. Army in 1981. During 1982, the development and operational testing was completed for the HMMWV, which led to the initial production contract. The U.S. Army Tank-Automotive and Armaments Command awarded the first HMMWV production contract in March 1983. The contract was a five-year contract, worth $1.2 billion to produce 55,000 HMMWVs. [Ref. 17] The HMMWV eventually replaced a variety of light tactical vehicles including the M151 ¼-ton utility vehicle, the M274 ¼-ton Mule, and the M561 1 ½-ton Gama Goat. Since production began in 1983, more than 150,000 HMMWVs have been delivered to the U.S. Armed Forces and more than 30 friendly overseas nations. [Ref. 18]

The current HMMWV is a light tactical wheeled vehicle equipped with a high performance 6.5L diesel engine, 4 speed automatic transmission, and full-time four-

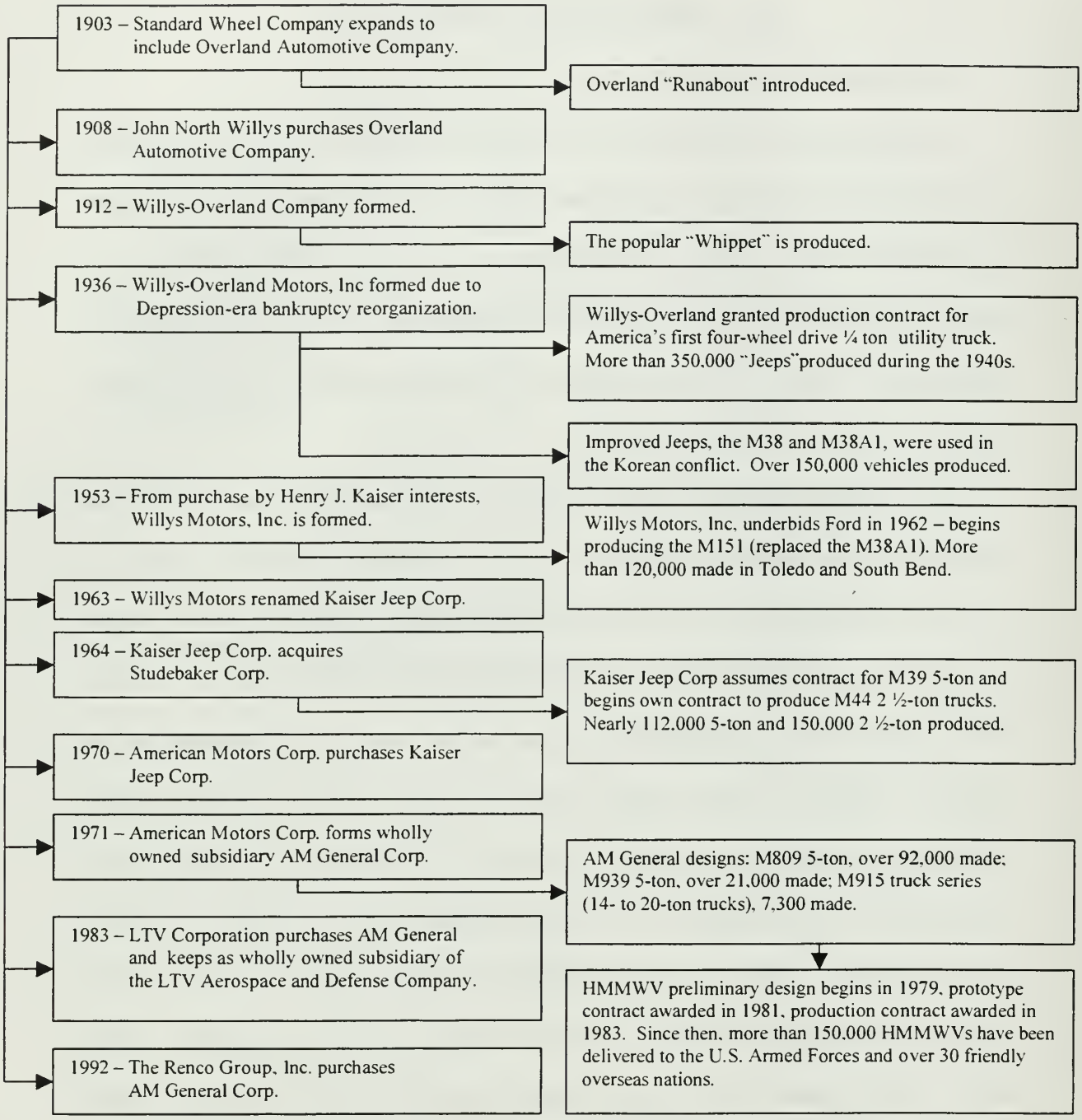

1903 – Standard Wheel Company expands to include Overland Automotive Company.
Overland "Runabout" introduced.
1908 – John North Willys purchases Overland Automotive Company.
1912 – Willys-Overland Company formed.
The popular "Whippet" is produced.
1936 – Willys-Overland Motors, Inc formed due to Depression-era bankruptcy reorganization.
Willys-Overland granted production contract for America's first four-wheel drive ¼ ton utility truck. More than 350,000 "Jeeps"produced during the 1940s.
Improved Jeeps, the M38 and M38A1, were used in the Korean conflict. Over 150,000 vehicles produced.
1953 – From purchase by Henry J. Kaiser interests, Willys Motors, Inc. is formed.
Willys Motors, Inc. underbids Ford in 1962 – begins producing the M151 (replaced the M38A1). More than 120,000 made in Toledo and South Bend.
1963 – Willys Motors renamed Kaiser Jeep Corp.
1964 – Kaiser Jeep Corp. acquires Studebaker Corp.
Kaiser Jeep Corp assumes contract for M39 5-ton and begins own contract to produce M44 2 ½-ton trucks. Nearly 112,000 5-ton and 150,000 2 ½-ton produced.
1970 – American Motors Corp. purchases Kaiser Jeep Corp.
1971 – American Motors Corp. forms wholly owned subsidiary AM General Corp.
AM General designs: M809 5-ton, over 92,000 made; M939 5-ton, over 21,000 made; M915 truck series (14- to 20-ton trucks), 7,300 made.
1983 – LTV Corporation purchases AM General and keeps as wholly owned subsidiary of the LTV Aerospace and Defense Company.
HMMWV preliminary design begins in 1979, prototype contract awarded in 1981, production contract awarded in 1983. Since then, more than 150,000 HMMWVs have been delivered to the U.S. Armed Forces and over 30 friendly overseas nations.
1992 – The Renco Group, Inc. purchases AM General Corp.

Figure 4. Brief History of AM General and the HMMWV [Data from Ref. 17]

wheel drive. The vehicle is air transportable and can be dropped from a variety of aircraft. The nomenclature for the base platform is M1097A2, which can be configured to support several different missions including weapons platform, field ambulance, cargo

and troop transport, and communications. [Ref. 19] Most of the configurations do not affect the HMMWV's ability to climb sixty percent slopes, traverse a side slope of up to forty percent, or ford a hard bottom water crossing up to 30 inches (without a deep water fording kit – up to 60 inches with the kit) while carrying a payload of 2,500 – 4,400 pounds, depending on the mission. [Ref. 20]

The current acquisition strategy for PM-LTV emerged after two significant events occurred in the late 1990s. First, in 1997, a new start program called the Light Tactical Vehicle (LTV) was cancelled. The LTV was originally intended to replace the HMMWV at the end of the HMMWV's Economic Useful Life (EUL). [Ref. 21] Secondly, in May of 1998 at the direction of Congress, the Secretary of the Army was to "...submit a light tactical wheeled strategy with the fiscal year 2000 budget" and "...include the requirements, estimated development and acquisition costs, and estimated operation and support costs for each alternative." [Ref. 22] The impetus for the formation of a new acquisition strategy for the Army's light tactical vehicles stemmed from these two events.

Next, an Integrated Process Team (IPT) was formed with members from U.S. Army Tank-automotive and Armaments Command (TACOM), the U.S. Army Training and Doctrine Command (TRADOC), who serve as the Army's combat developers, and PM-LTV to conduct the Analysis of Alternatives (AOA) to fulfill the Congressional mandate. The IPT's results were incorporated into the formulation of the acquisition strategy for the Project Manager, Light Tactical Vehicles (PM-LTV).

The TACOM Deputy for Systems Acquisition appointed Ms. Nancy Moulton as the Project Manager (PM) for the Light Tactical Vehicle (LTV) program on June 29, 1998. As the PM for LTV, she is tasked to "...provide overall direction and guidance for

the development, acquisition, testing, systems integration, product improvement, and fielding [of her assigned vehicles]...." [Ref. 23] Her mission is to "...provide world-class light tactical vehicles to meet the needs of the joint warfighting community. This mission will be accomplished using a customer-focused approach and the following enablers: an integrated data environment/integrated business environment, cost as an independent variable, leveraging commercial technology and integrated process teams." [Ref. 24] The PM-LTV falls under the Deputy for Systems Acquisition (DSA), U.S. Army Tank-automotive and Armaments Command (TACOM) and is headquartered in Warren, Michigan.

To support TACOM and accomplish the PM-LTV vision and mission, PM-LTV is organized as depicted in Figure 5. PM-LTV is not just the HMMWV, but rather a category of vehicles that includes various configurations of the HMMWV, the Armored Security Vehicle (ASV), the High Mobility Trailer (HMT) and the Commercial Utility Cargo Vehicle (CUCV). However, "the U.S. Army Light Tactical Fleet has been standardized as the ...HMMWV." [Ref. 21]

The program office performs a variety of complex tasks related to managing the Army's LTV program such as logistics and maintenance support planning, configuration management, quality assurance, engineering support, reliability predictions and assessments, procurement and production planning, and cost and schedule management. Due to their relatively small size (24 personnel), PM-LTV relies on matrix support from TACOM and other Major Subordinate Commands (MSC). [Ref. 21]

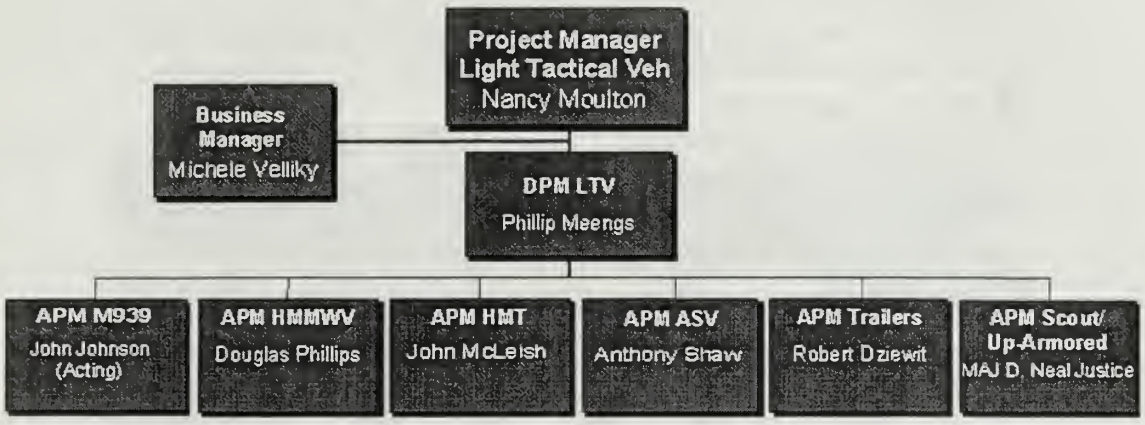


Figure 5. Program Office for LTV [From Ref. 23]

B. ACQUISITION STRATEGY

On the 25th of January 1999, the Project Manager for Light Tactical Vehicles (PM-LTV) published the US Army Acquisition Strategy Report for Light Tactical Vehicles. The Army was required to prepare and submit the report to Congress with the Fiscal Year (FY) 2000 budget, see Appendix A. This section outlines and describes important characteristics of PM-LTV's acquisition strategy.

The acquisition strategy for PM-LTV details how the Army plans to manage the total life cycle of the HMMWV fleet. Several organizations have impacted, influenced and shaped the strategy either directly or indirectly. These organizations include Congress, Office of the Secretary of Defense, Office of Secretary of the Army, TACOM, TRADOC, and other service participation from the US Marine Corps, Marine Corps Systems Command (MARCORSYSCOM).

The Army Acquisition Executive (AAE), high level Department of the Army (DA) executives, and General Officers provided the PM-LTV a host of guidance to consider when formulating their strategy. A partial list of those contributions follows:

- No new start program
- Fleet is aging; however, must meet Army needs until Army After Next (AAN)
- Leverage commercially available technology
- Introduce competition (none exists today)
- Look at alternatives to mandatory replacement of vehicles reaching their EUL
- Support Joint Vision 2010 and Army Force XXI goals
- Support AAN goals
- Maintain performance at least as good as the performance of the fleet today
- Do not increase Operations and Support (O&S) costs
- Consider extending the life of the HMMWV
- Support the USMC replacement strategy; they are our partners

The centerpiece of their strategy is employing a three-pillar approach to comply with the above guidance and manage the life cycle costs of the HMMWV. The three pillars are Spiral Modernization, Maintain Production, and Recapitalization, as shown in Figure 6. Spiral Modernization utilizes a seven-year cyclical approach to insert commercial technologies that fulfill Army Force XXI requirements. Maintain Production aims to acquire the necessary number of vehicles to meet the Army Acquisition Objective (AAO) of 121,692 HMMWVs of various models [Ref. 21] and satisfy identified requirements for the US Air Force and US Marine Corps. The goal during Recapitalization is to extend the service life of aging HMMWVs. Although the HMMWV fleet is aging, almost half of the vehicles have less than 18 thousand miles accumulated from use, with the fleet's Economic Useful Life (EUL) at 15 years. Recapitalization attempts to add 21 years to the service life of the HMMWV by improving the Reliability, Maintainability, and Availability (RMA) concurrently with improvements in the corrosion protection of the HMMWV.

The strategy, then, describes the plan to address the shortfalls associated with the aging HMMWV fleet, fill AAO shortages, and extend the service life of aging

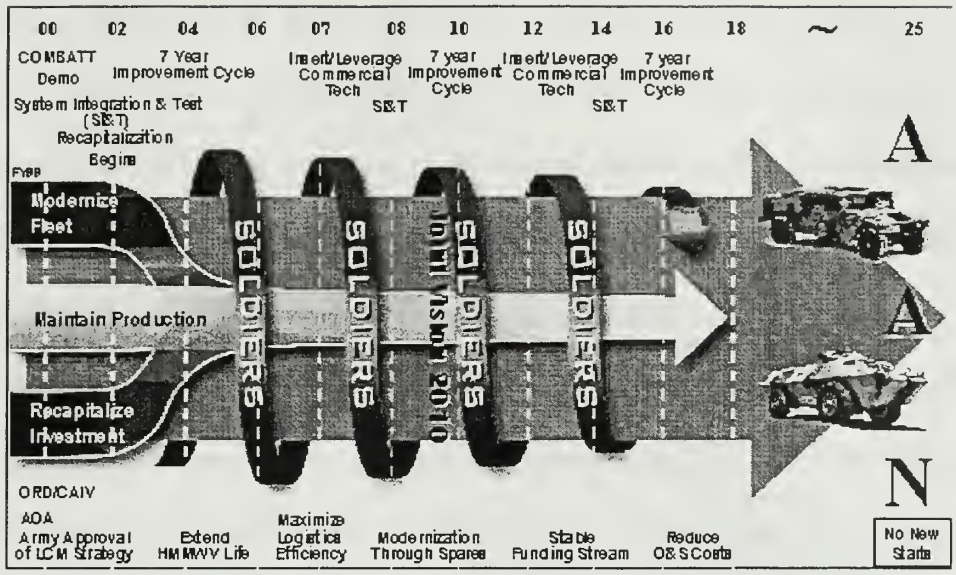


Figure 6. PM-LTV Acquisition Strategy [From Ref. 24]

HMMWVs by 21 years. The following paragraphs provide a more detailed description for each of the pillars.

1. Spiral Modernization

The goal of spiral modernization is to cyclically improve and evolve the HMMWV into a vehicle capable of satisfying the Joint Vision 2010 requirements (effective around 2010) and Army After Next (AAN) requirements (effective around 2025) "at a reduced cost by developing, encouraging, and leveraging commercially available technologies." [Ref. 21] PM-LTV identified five areas of emphasis that will contribute to successfully accomplishing spiral modernization. Those five areas are Operational Requirements Document Update; Technology Demonstration; System Integration and Testing; Production, Fielding/Deployment and Operational Support; and Future Plans.

The first area contributing to successful spiral modernization is Operational Requirements Document (ORD) Update. The intent here was to address those risk issues and challenges associated with incongruities between the fielded HMMWV and a new, updated ORD on a cyclical basis. Each successive iteration of the spiral modernization cycle would produce an updated ORD that delineates thresholds "...reflecting realistic requirements for today's fleet and objectives that reflect the requirements necessary to meet projected Force XXI requirements." [Ref. 21] Those requirements would then be addressed and incorporated into the HMMWV through subsequent phases of the spiral modernization process.

A Cost/Performance Trade-off IPT (with combat developer involvement) methodology was used to mitigate the identified risk issues. The IPT is applying Cost As an Independent Variable principles as shown in Figure 7.

Another contributor to successful spiral modernization is Technology Demonstration. The goal here is to leverage the commercial marketplace by incorporating existing advanced technologies into the HMMWV program; jointly developing dual use technologies for militarized commercial components; and invigorating competition in the marketplace through foreign comparative testing.

The System Integration and Testing (SI&T) phase (FY00 to FY02) of spiral modernization provides Research, Development, Test & Evaluation (RDT&E) funding to support technology insertion initiatives that are linked to ORD requirements or linked to Operations and Support (O&S) costs savings from a systems perspective. Areas of interest pertinent to ORD requirements include maintainability, durability, and maximum maintenance man-hours per operating hour. Areas linked to O&S costs savings consist of

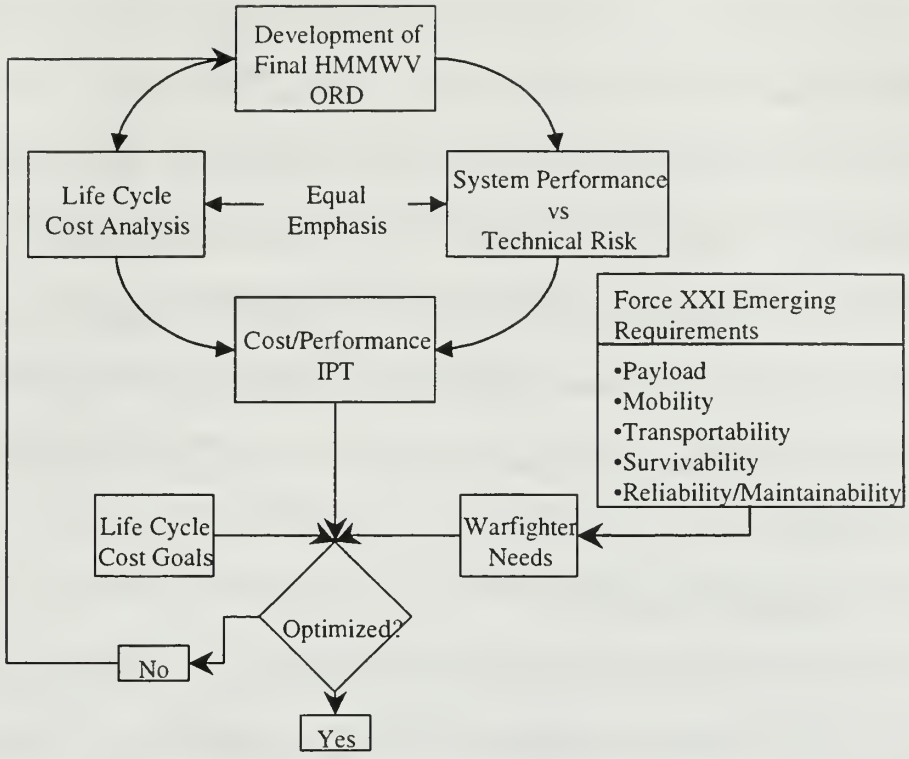


Figure 7. C/PT IPT CAIV Process [After Ref. 21]

corrosion prevention, electronics, and integration of the HMMWV with other components on the Digital Battlefield, among others. Performance based specifications at the component level will be utilized during this phase.

Following the SI&T phase and contingent upon available FY02 Funding, Production, Fielding/Deployment and Operational Support will increase production of the HMMWV to modernize 100 percent of Force Packages 1 and 2 units over a 21-year period. Force packages are pre-defined standardized combinations of manpower and/or equipment that provide a specific wartime capability. [Ref. 25] A unit included in Force Package 1 has priority over a unit included in Force Package 2; Force Package 2 units

have priority over Force Package 3 units, and so on. When combined with the recapitalization production quantities, the intent in this phase is to improve the entire HMMWV fleet and extend the expected life to a minimum of 21 years.

The last component supporting the spiral modernization pillar is Future Plans. The idea here is to repeat the spiral modernization cycle every seven years. The cyclical nature of the modernization process allows the HMMWV program to evolve with subsequent warfighter requirements (reflected in updated iterations of the ORD), keep up with emerging technologies, and obtain "leap ahead" technologies and integration that the AAN may require.

2. Maintain Production

The current production efforts are needed to sustain the fleet until modernization efforts are realized. PM-LTV identified several reasons for keeping a warm production base [Ref. 21]:

- Provide a safety net and contingency plan if the modernized HMMWV production contract should encounter delays.
- Allow the Army to continue to fill Army Acquisition Objective (AAO) shortages while planning for the future.
- Meet critical interchange to high priority systems.
- Provide a means to accomplish tech inserts.
- Provide vehicles to other services.
- Fill Foreign Military Sales (FMS) orders.

The production plan reflected in the acquisition strategy calls for 136,145 units to be produced through FY99 (103,419 for Army; remainder for USMC, USAF, and Foreign Military Sales (FMS)). After AM General completes the fixed-price five-year requirements contract (through FY99), a sole source extension of the current contract

would continue to fill shortages in the AAO and support USMC requirements, potentially to FY05, with an additional 17,259 units produced. [Ref. 21]

Operation and Support (O&S) cost reduction efforts are still emphasized throughout this phase. For example, "corrosion prevention enhancements and high cost driver improvement changes such as the Electric Start System (ESS) to reduce glow plug, protective control box, starter and flywheel consumption" are pursued through the term of the contract (potentially through FY05). [Ref. 21]

3. Recapitalization

The PM-LTV accomplishes the Recapitalization effort using two distinct phases that attempt to extend the service life of the current HMMWV platform by 21 years, at an acceptable level of O&S cost. The first phase is Prototype and Test (PAT) commencing in FY00 and FY10, while the second phase, Production, begins in FY01, FY06, and FY11. The first iteration of the Recapitalization process (PAT FY00 and Production FY01) initializes the baseline for subsequent iterations.

During PAT, technology insertion initiatives directly linked to O&S cost savings or overall improvements in vehicle performance are developed and validated utilizing RDT&E funding. This phase establishes which initiatives and Modification Work Orders (MWO) will be incorporated into the production of recapitalized HMMWVs. Another task completed in this phase is the development of criterion used to screen prospective candidates for inclusion in the recapitalization production phase. Criteria will developed "...that will allow flexibility while addressing age, condition (corrosion), mileage, EUL/Military Useful Life considerations, Maintenance Expenditure Limits (MEL), excessive O&S costs, and the ability to only repair as necessary proven, reliable

components." [Ref. 21] Economic life refers to "the period of time over which the benefits to be gained from a system may reasonably be expected." [Ref. 26] The purpose of MEL is to cap maintenance expenditures to prevent spending more than the value of the vehicle on repair costs for a particular vehicle. As a vehicle ages and its value decreases, the MEL also decreases. [Ref. 7]

The Production phase of Recapitalization incorporates efficiencies and cost savings gained from new HMMWV production, where possible. Unanticipated upgrades and modifications throughout the five-year production run should be minimal due to efforts put forth in the previous phase. During routine HMMWV maintenance actions, users will identify candidates for induction into Recapitalization Production from criteria developed during the PAT phase. Vehicles and components too deteriorated or otherwise unusable will be disposed of with the intent of harvesting funds (scrap or salvage value) to reinvest in the recapitalization effort.

The PM-LTV believes this strategy represents the best plan for "the most cost effective Life Cycle Management of the HMMWV fleet." [Ref. 21] Through spiral modernization, continued production, and recapitalization, PM-LTV intends her acquisition strategy to meet the mission requirements and fulfill the AAO.

C. CHAPTER SUMMARY

The AM General Corporation began design work for the HMMWV program as early as 1979. After receiving a competitive prototype contract in 1981, AM General completed the development and operational testing for the HMMWV in 1982. The TACOM awarded the first HMMWV production contract in March 1983 to AM General,

worth $1.2 billion to produce 55,000 HMMWVs. Since production began in 1983, more than 150,000 HMMWVs have been delivered to the U.S. Armed Forces and more than 30 friendly overseas nations.

Through a collaborative effort with members from TACOM and TRADOC, the PM-LTV's acquisition strategy emerged while conducting an AOA, using an IPT process, in February of 1998. The TACOM DSA then appointed Ms. Nancy Moulton as the Project Manager (PM) for the Light Tactical Vehicle (LTV) program on June 29, 1998. The program office for LTV performs several tasks while managing the HMMWV program with the assistance of representatives from TACOM and other Major Subordinate Commands.

The centerpiece of Ms. Moulton's acquisition strategy is employing a three-pillar approach to manage the life cycle costs of the HMMWV fleet. The end result will achieve the AAO, extend the service life of the HMMWV by 21 years, and meet evolving operational requirements. The three pillars of the acquisition strategy are Spiral Modernization, Maintain Production, and Recapitalization.

Spiral Modernization utilizes a seven-year cyclical approach to insert commercial technologies that fulfill Army Force XXI requirements. The seven-year cycle includes an ORD Update; Technology Demonstration; System Integration and Testing; and Production, Fielding/Deployment and Operational Support.

Maintain Production aims to acquire the necessary number of vehicles to meet the Army Acquisition Objective (AAO) of 121,692 HMMWVs. This facet of the acquisition strategy depends upon an extension of the current production contract (FY99) out to FY05.

Recapitalization extends the service life of aging HMMWVs (from 15 to 36 years). This component of the acquisition strategy uses a two-phase approach – Prototype and Test (PAT) is the first phase, Recapitalization Production is the second. During the PAT phase, technological insertions that will lead to O&S cost savings or vehicle performance improvements will be developed, validated, and selected for incorporation into the follow-on phase. Finally, the Recapitalization Production phase produces a HMMWV capable of an additional 21 years of service.

IV. ANALYSIS

A. INTRODUCTION

The sections that follow analyze the PM-LTV Acquisition Strategy (AS) to determine how MTS is implemented for the HMMWV program. Activities and tasks as delineated in PM-LTV's AS will be compared with those activities and tasks found in the MTS OIPT's implementation guidance for MTS. The comparison will be used to establish the extent to which PM-LTV implements MTS; identify the methods used for MTS implementation in order to comply with the Army's strategy for MTS; and determine if the goals of MTS have been achieved.

A timeline of key events in the development of MTS and PM-LTV's new acquisition strategy, as shown in Figure 8, provides a perspective of how the two processes progressed. The MTS process and the new acquisition strategy for PM-LTV both evolved during the latter half of the 1990s. Just as the Army redirected its emphasis on the AOA for a light tactical vehicle to exclude a new start program, the MTS OIPT was finalizing its guide for the implementation of MTS for the Army. A few months after the MTS guide was published in early 1998, the DSA of TACOM appointed Ms. Nancy Moulton as the PM for LTV. Shortly thereafter, Congress (through the House Appropriations Committee) directed the Army to submit its strategy for light tactical wheeled vehicles with the Army's FY00 budget. The PM-LTV analyzed the preliminary results from the AOA, developed the AS, and published the strategy January 25, 1999, for inclusion in the FY00 budget.

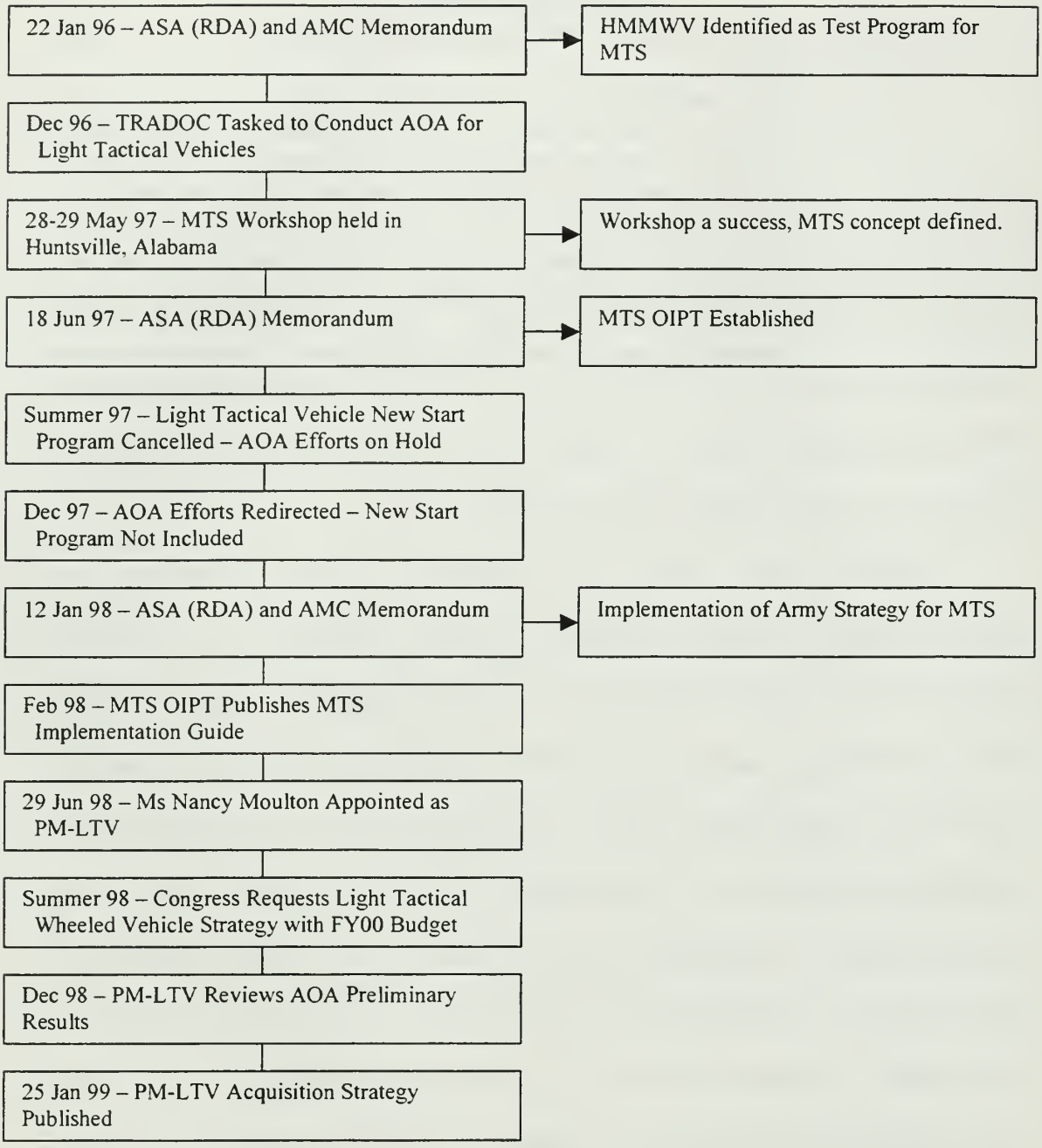

22 Jan 96 – ASA (RDA) and AMC Memorandum
HMMWV Identified as Test Program for MTS
Dec 96 – TRADOC Tasked to Conduct AOA for Light Tactical Vehicles
28-29 May 97 – MTS Workshop held in Huntsville, Alabama
Workshop a success, MTS concept defined.
18 Jun 97 – ASA (RDA) Memorandum
MTS OIPT Established
Summer 97 – Light Tactical Vehicle New Start Program Cancelled – AOA Efforts on Hold
Dec 97 – AOA Efforts Redirected – New Start Program Not Included
12 Jan 98 – ASA (RDA) and AMC Memorandum
Implementation of Army Strategy for MTS
Feb 98 – MTS OIPT Publishes MTS Implementation Guide
29 Jun 98 – Ms Nancy Moulton Appointed as PM-LTV
Summer 98 – Congress Requests Light Tactical Wheeled Vehicle Strategy with FY00 Budget
Dec 98 – PM-LTV Reviews AOA Preliminary Results
25 Jan 99 – PM-LTV Acquisition Strategy Published

Figure 8. Key Events for Current PM-LTV & MTS [From Data Compiled by Author]

B. MTS VERSUS PM-LTV ACQUISITION STRATEGY

There are three major divisions of the tenets associated with the MTS process: those that are peculiar to programs in the Pre-Milestone III phase; those that are peculiar to programs in Post-Milestone III phase; and those that are generic to any program. Even though the HMMWV program is in Phase III, Production, Fielding/Deployment, and Operational Support (PFDOS), two of the pillars of PM-LTV's AS reflect activities conducted in Pre-Milestone III Phases (phases 0, I, and II, are Concept Exploration, Program Definition and Risk Reduction, and Engineering and Manufacturing Development, respectively). Those two pillars are Spiral Modernization and Recapitalization. The third pillar of their acquisition strategy, Maintain Production, matches activities associated with the Post-Milestone III phase, PFDOS. The following sections compare the PM-LTV's AS to each of the major divisions of the MTS process, accordingly.

1. Pre-Milestone III MTS Tenets

This section addresses the activities and tasks outlined in two of the pillars of PM-LTV's AS – Spiral Modernization and Recapitalization. The goal of MTS in the development phases (Pre-Milestone III) is to assure developmental programs enable the continuous updating of technology in spares throughout their useful life. The six tenets identified from the MTS guidelines that are necessary for successful MTS implementation for a developmental program will be compared to the PM-LTV AS and discussed first. A section summary follows illustrating the degree of MTS implementation for a program in the developmental phases as reflected in the PM-LTV AS.

Require that the system be designed as an open system. A system or product with an open systems design is one with a *design* able to incorporate the newest commercial technology, products, processes, and practices as they evolve in the marketplace.

The PM-LTV AS does not stipulate an open design for the HMMWV in either the Spiral Modernization or Recapitalization pillars. However, they come close to addressing an open system design in the Spiral Modernization pillar by stating "efforts will be made to create a system that allows more seamless integration as the highest density vehicle on the digital battlefield to provide a 'plug & play' type adaptable combat platform for various mission critical joint task force systems." [Ref 21] It seems necessary to have an open systems design and architecture to achieve the desired adaptable platform, but there was no specific language addressing an open systems design.

Their design for the spiral modernization strategy plans for technical insertions and the development and leveraging of commercial technologies on a seven-year cyclical basis. Also, it is obvious that PM-LTV desires technology insertion throughout the remainder of the HMMWV's useful life to keep pace with existing technologies in the marketplace and provide a system that meets the emerging requirements of the warfighter. Without an open systems design, the HMMWV system is limited to accepting components, subsystems, or systems that match the form, fit, and function of the piece being replaced. Otherwise it would require extensive redesign of other components or interfaces affected by the technology insertion that are incompatible.

With an open systems design, you have fewer constraints placed on technical insertions for form, fit, or function.

The PM-LTV may not be able to influence the design of the HMMWV due to its mature design. In order to control costs, reduce the risk associated with developing a new system, and benefit from the recapitalization of aging HMMWVs, the existing HMMWV was chosen as the baseline for future modernization efforts. Therefore, requiring an open systems design for the overall HMMWV system may be cost prohibitive. However, all reengineering efforts associated with HMMWV modernization programs could benefit from requiring an open-systems design and limit modification to achieve future technology insertion.

Develop performance specifications at the repairable/provisioned levels. It is important to carefully document the functional and physical system interfaces in the performance specification to ensure the acquisition of interchangeable and interoperable replacement parts and to ensure the opportunity exists to refresh the technology with each subsequent spares buy.

The PM-LTV has fully embraced performance specifications. The use of performance specifications is most evident in the Spiral Modernization pillar, although the Recapitalization pillar will harvest some benefits from the linkage between the two pillars (technologies discovered in the systems integration and test phase of Spiral Modernization are incorporated into the Recapitalization effort, where practicable). Performance specifications are emphasized both at the system and component level during the systems integration and test phase. This provides more freedom for the contractor to design a creative solution that meets or exceeds the requirements without

being constrained by strict design specifications. PM-LTV should reap benefits from the reduction of costs associated with a contractor not having to comply with multiple design specifications, like the CECOM's User Readout (URO) for the Enhanced Position Location Reporting System (EPLRS) project that reduced the per unit price from $4,000 to less than $1,000 (see Chapter II, section B.1. Advantages of MTS).

Use CAIV principles in the design of spares. Instead of determining the level of repair (echelon of maintenance and its corresponding location of the repair such as in the field or maintenance depot) for a particular component, set a CAIV objective for the cost of the component. The developer determines the level of repair based on affordability and readiness considerations, and the support structure evolves that reflects the least-cost spares approach.

The use of CAIV is specifically identified by PM-LTV in the Spiral Modernization pillar, during the ORD update. The CAIV principles employed in this stage of the modernization cycle are very beneficial to mitigate the risk of cost overruns and designing a cost prohibitive system. Using those principles demonstrates to the user that each performance specification has an associated cost and that trade-offs between performance and cost will most likely be required to field an affordable system. The user participates in the cost-benefit analysis of added requirements and makes trade-offs that balance mission requirements and fiscal constraints.

Although the PM-LTV AS does not specifically address the use of CAIV principles in the design of spares, it is clearly evident that the PM-LTV is concerned with the cost of modernizing the HMMWV from a systems, fleet, and total life-cycle perspective throughout each of the pillars of the AS. Modernization initiatives and

technological insertions are only undertaken if they are directly related to an ORD requirement or can demonstrate affordability and reduction in O&S costs. The recurring theme through each of the pillars is reducing or minimizing O&S costs. Hence, modernization techniques identified in the AS are not arbitrarily instituted without consideration of implementation costs, and therefore the essential CAIV tenets are addressed.

Even though all three pillars of the AS reflect a genuine concern for acquisition and O&S costs, the details of how the PM will mitigate or eliminate those concerns could be better articulated. The PM-LTV has set clear objectives and goals for each of the pillars to reduce and minimize O&S costs together with introducing competition to lower acquisition costs. But that is the desired end-state. The use of CAIV principles provides a tool to ensure each decision contributing to component design or modernization initiative is made with cost ramifications in mind and that the user is an active participant in the analysis and resulting decisions. The principles increase the likelihood of achieving the desired end-state.

How PM-LTV plans to reach the desired end-state is better articulated in the Program Management section of the AS. It is much more clear that PM-LTV will establish thresholds and metrics, apply CAIV processes, conduct cost/benefit and tradeoff analyses, and use Earned Value Management (EVM) techniques to manage program costs and performance. These techniques and procedures would have a greater impact if they were incorporated, intertwined, and supporting each of the pillars of the AS, serving as the roadmap and guide for IPT members to follow.

Have the contractor maintain configuration control of product data. Giving configuration control of product data to the contractor preserves the contractor's design flexibility and ability to continually refresh technology.

The AS for PM-LTV does not specify who has the configuration control of product data. The AS does stipulate that the Government will retain configuration management control and approval authority. And, during the Spiral Modernization effort, the control of configuration management will be exercised through performance specifications using the current Technical Data Package (TDP) provided as a reference document. The AS also states "we will encourage performance-based specifications starting at the component level...." [Ref. 21]. Since they encourage performance-based specifications for the design of technology insertion initiatives and do not direct the use of design specifications, a fair conclusion is that they permit the contractor to retain configuration control of the product data and will reap the benefit by allowing contractor data control.

Employ some form of contractor logistic support. The use of contractor logistics support may reduce the cost of spares and logistics support, particularly if the contractor providing the support is also the production contractor. The production contractor has intimate knowledge of the system and already has processes in place for the support of the system and the acquisition or production of spares. The opportunity may exist to achieve economies of scale if the production contractor also provides some form of support.

The use of Contractor Logistic Support (CLS) in the two Pre-Milestone III pillars was not evident. Additionally, it is unclear if CLS will be a consideration for either the

Spiral Modernization or Recapitalization efforts. However, the Support section of the AS reflects a deliberate desire to use contractor logistic support on an interim basis until appropriate standard supply levels of repair parts can be established. This interim support is directed more toward the modernization production effort and not specifically for the acquisition of spares. Therefore, PM-LTV misses an opportunity to achieve some spares procurement cost reductions through the production contractor's economies of scale.

Use the developer for follow-on production. The developer has extensive knowledge of the system or product that might prove to be beneficial during the transition from development to production. Other competition for spares procurement may be introduced once the product data have stabilized.

PM-LTV has identified that the potential exists to have no competition for AM General in the production phase of the Spiral Modernization pillar. Although this may be advantageous for the PM office as they transition to the production effort from the development phase, the opportunity to reduce the costs associated with the acquisition of spares is lost. The PM-LTV's mitigation plan is to enter into a teaming arrangement with AM General to introduce competition at the component level for efforts past the Milestone III decision. Competition has the potential to bring down the acquisition costs of spares but may also increase the costs due to integrating components from different manufacturers into operable subsystems or systems.

Summary of MTS development tenets. Figure 9 summarizes how well the developmental MTS tenets are achieved by the two Pre-Milestone III pillars of PM-LTV's AS. A solid arrow indicates the MTS tenets are well represented in the particular pillar of the AS. A dashed arrow indicates the tenets are represented but only because of

the benefits received by Recapitalization through Spiral Modernization Efforts. In other words, most activities specifically delineated in the Recapitalization pillar do not represent MTS tenets by themselves.

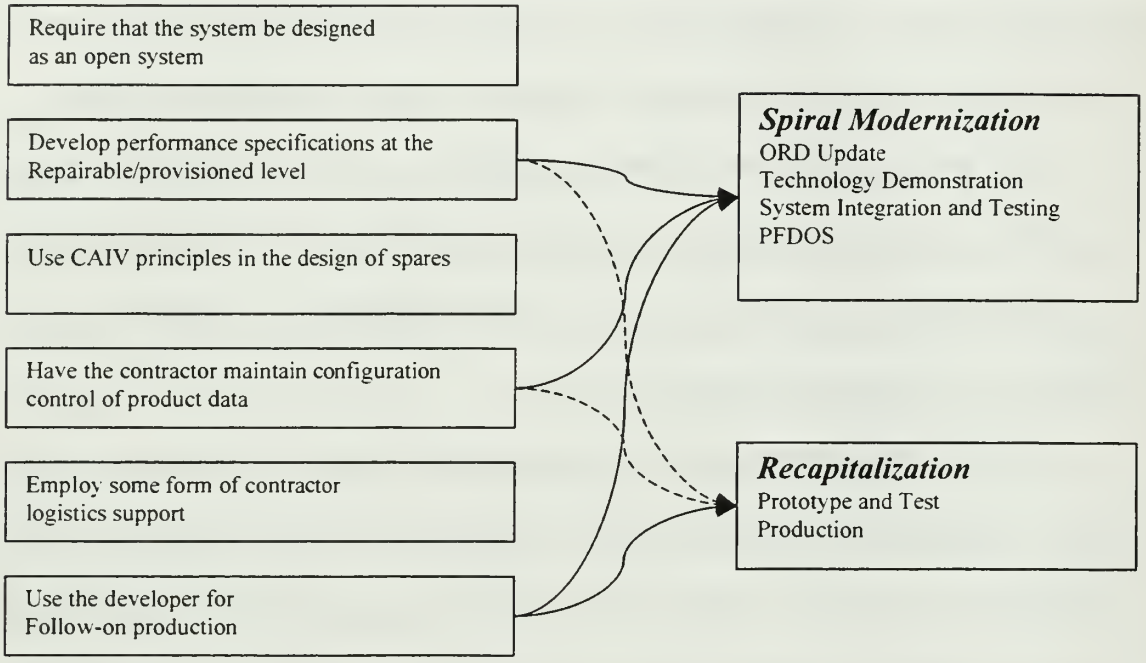

Require that the system be designed as an open system
Develop performance specifications at the Repairable/provisioned level
Use CAIV principles in the design of spares
Have the contractor maintain configuration control of product data
Employ some form of contractor logistics support
Use the developer for Follow-on production
Spiral Modernization
ORD Update
Technology Demonstration
System Integration and Testing
PFDOS
Recapitalization
Prototype and Test
Production

Figure 9. Development Tenets of MTS and the Pre-Milestone III Phases of PM-LTV's Acquisition Strategy [From Data Compiled by Author]

The two pillars of Spiral Modernization and Recapitalization do provide a framework to enable the HMMWV to incorporate new technologies as they emerge in the commercial marketplace. And as such, they appear to meet the goal of MTS for a program in the developmental phases. However, while many of the activities conducted in the two pillars closely resemble some of the tenets supporting an MTS strategy for a developmental program, the activities are directed more toward the overall modernization of the HMMWV fleet (using other techniques) and not particularly through a spares

modernization effort. The two pillars of the AS emphasize developmental activities and the production effort leading up to a modernized or recapitalized HMMWV, with little emphasis for the spares acquisition. Three of the MTS tenets in Figure 9 are not addressed by PM-LTV's AS which further illustrates that the focus of their strategy is not necessarily toward spares modernization but rather modernization production of the system.

2. Post-Milestone III MTS Tenets

This section compares the MTS tenets associated with a program in the Production Fielding/Deployment and Operational Support (PFDOS) phase to those activities and tasks outlined in the Maintain Production pillar of PM-LTV's AS. There are three goals of MTS in the Post-Milestone III phase: update spares currently being acquired with modern technology where the cost benefit is the greatest; leverage spares procurement dollars to update technology within current funding levels; and capture savings in spares acquisition and support costs for reinvestment in Army force modernization. Four tenets were identified from the MTS guidelines that are necessary for successful MTS implementation in a Post-Milestone III program. A section summary follows illustrating the degree of MTS implementation for a program in the PFDOS phase as reflected in the PM-LTV AS.

Implement a systematic and disciplined review of spares demand experience, acquisition lead times, prices, inventories, O&S costs, failure rates, obsolescence, repair cycle times and repair wash-out rates. The objective of this tenet is to use the Integrated Process Team (IPT) concept to develop and prioritize a list of spares that are the cost drivers of the system. The analysis goes beyond the acquisition cost of the spare

and includes the factors named in the above tenet (e.g., failure rates, inventories, acquisition lead times, etc.).

The PM-LTV uses the IPT process to conduct business and manage the HMMWV program. Additionally, a desire to continue O&S cost reduction efforts in the Maintain Production pillar is apparent but no specific actions or procedures are identified to achieve those desires.

A bit more detail is provided in the Support Concept section of the AS. As stated in that section, "...we will use a continuous process that will determine the O&S cost drivers, provide for a cognitive technical review and recommend changes or alternatives that will lower operating and support costs throughout the life cycle of the equipment." [Ref. 21] It seems this statement meets the tenet's intent, although the quoted statement is the extent of the level of detail provided to achieve O&S cost reductions. Also, it is unclear if the focus is on the initial procurement of spares or those spares necessary to sustain the system once fielded. The statement would be more beneficial in the Maintain Production pillar with some additional details to provide further clarity for the IPT to attain the desired outcome of O&S cost reduction.

The Support Concept section asserts alternative strategies such as Electronic Commerce (EC), Direct Vendor Delivery (DVD) and digital tools like Interactive Electronic Technical Manuals (IETM) will be analyzed and utilized to the maximum extent possible to reduce life cycle costs of the HMMWV program. These sorts of details are precisely the missing element of the Maintain Production pillar and would significantly improve the IPT's understanding of how to realize the O&S cost reductions. Including (or restating, if necessary) the details in the Maintain Production pillar

reemphasizes the importance of and the PM's commitment to reducing the life cycle costs of the system.

Analyze the MTS spares priority ranking to determine the feasibility of upgrading technology to reduce the spares' life cycle cost. The MTS strategy must include a feasibility analysis that considers the state of the technology of the spare, emerging or existing technology in the marketplace, and the impact of the new technology integration on the total life cycle cost of the system. Aggregating the sparing to the next higher assembly may prove to be valuable and is an important facet of the analysis.

PM-LTV's emphasis on this tenet is much like the previous tenet. No details are given in the Maintain Production pillar while only a glimmer of detail is contained in the Support Concept section. Assuming "a cognitive technical review" includes a prioritized ranking of spares modernization candidates, PM-LTV appears to adequately fulfill this tenet. Their use of digital tools and analysis of commercial practices for implementation in the HMMWV program should provide valuable information to accurately select and support the MTS candidate decision, though the pillar does not make that connection specifically.

Prepare procurement work packages for spares that enable integration of technology upgrades as a normal part of the procurement cost. Spares contracts should be structured to allow for the continuous upgrading of technology into spares components where the cost of the upgrade is included in the acquisition cost.

The lack of detail in the Maintain Production pillar applies to this tenet as well. The contracting strategy is reflected in the AS under the Business and Contracting

Strategy section. Although the majority of the emphasis in their contracting strategy results in modernization and recapitalization production of the HMMWV system, the strategy provides ample emphasis and closely resembles the suggested strategy from MTS for spares procurement. PM-LTV decidedly implements performance specifications to competitively acquire components, which will allow the contractor flexibility to insert technologies as they emerge, provided reengineering efforts contain provisions for open systems architecture.

Capture savings in spares acquisition and support costs resulting from MTS efforts for reinvestment in modernization. PM-LTV intends to capture funds generated by the recapitalization effort of the aging HMMWVs and reinvest the funds to support the modernization effort. The program office does not have access to any savings or authority to reprogram funds resulting from MTS cost reduction efforts. The savings would be reflected in reductions of requirements in the Operation and Maintenance, Army (O&MA) account and is beyond the scope of PM-LTV's ability. However, PM-LTV could attempt to seek "credit" for investments benefiting the O&MA account from the Army comptroller and obtain additional procurement or RDT&E funding within the appropriation's reprogramming limitations.

Summary of MTS PFDOS tenets. Figure 10 summarizes how well the PFDOS MTS tenets are achieved by the Maintain Production pillar of PM-LTV's AS. Although not specifically addressed and detailed in the pillar, other sections of the AS speak to activities conducted to maintain production and therefore would fulfill the PFDOS tenets. The AS of PM-LTV falls short of meeting the last goal of MTS for PFDOS programs - capture savings in spares acquisition and support costs for reinvestment in Army force

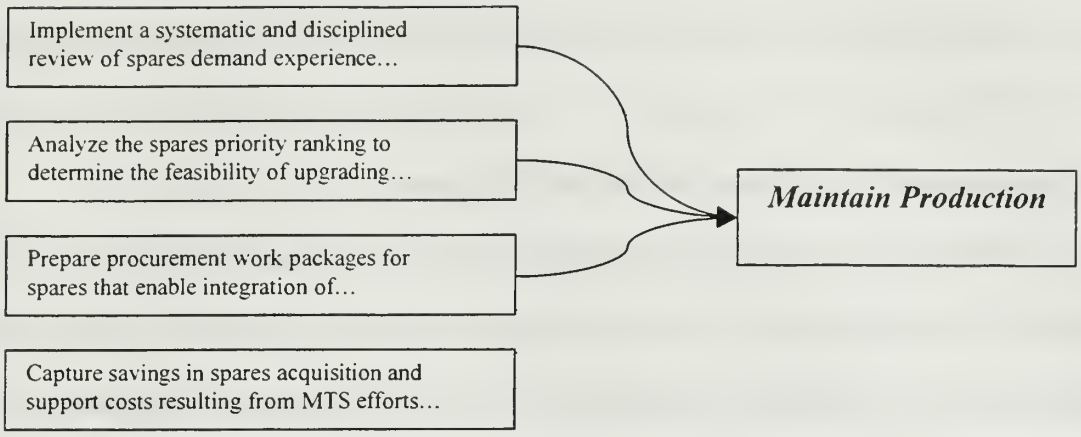

Implement a systematic and disciplined review of spares demand experience...
Analyze the spares priority ranking to determine the feasibility of upgrading...
Prepare procurement work packages for spares that enable integration of...
Capture savings in spares acquisition and support costs resulting from MTS efforts...
Maintain Production

Figure 10. PFDOS Tenets of MTS and the Post-Milestone III Phase of PM-LTV's Acquisition Strategy [From Data Compiled by Author]

modernization. An opportunity exists for PM-LTV to recapture some investment costs for initiatives undertaken in the spirit of MTS.

3. Generic MTS Tenets

This section analyzes the MTS tenets that all programs should use regardless of which acquisition phase the program is in and compares them to the AS for PM-LTV. The following three tenets identified from the MTS guidelines form the framework and foundation that is necessary for successful MTS implementation. A section summary will illustrate the degree of MTS implementation of these generic tenets as reflected in the PM-LTV AS.

Use an MTS IPT. The IPT members must have extensive knowledge of the broad range of Acquisition Reform (AR) initiatives and use that knowledge to develop and effectively execute MTS implementing tasks.

It is evident from their AS that the PM-LTV clearly believes in accomplishing tasks using the IPT process. Many functions are completed with support from other organizations. The current program office has used an IPT approach since the Army's

senior leadership redirected efforts of the AOA. PM-LTV participated in the AOA and used an IPT approach to develop their AS. They are committed to using an IPT approach for the continued management of the HMMWV program.

The AS does not address an MTS IPT. Absent the specific identification of an MTS IPT, the closest PM-LTV comes to achieving this is contained in the Support Concept section. Although not labeled as an MTS IPT, the steps and actions described in the Support Concept section reflect those actions undertaken in an MTS IPT. The CAIV principles are understood and applied, Earned Value Management techniques are used to minimize program costs, and intentions to reduce O&S costs are evident throughout each of the three pillars of the AS, all accomplished utilizing "a continuous process". However, an IPT labeled as an MTS IPT highlights its focus, direction, and mission. Modernization is then achieved through spares, not recapitalization or production of a new system.

Analyze overall program acquisition strategies. All strategies contained in the AS need to be revisited with the intent of implementing MTS to achieve modernization benefits from spares acquisitions.

The PM-LTV inherited the Army's LTV program just as the change in the direction of the AOA occurred. PM-LTV reviewed the previous LTV AS signed by the TACOM DSA in June of 1998. With the assistance of many outside organizations under a working group format, PM-LTV and the group developed and refined six alternate acquisition strategies. The group felt that the alternative selected and included in the AS represented the best alternative to meet the ORD requirements and the AAO. Hence the

program did receive a fresh review for modernization alternatives, but that review did not have the requisite MTS component.

Incorporate MTS into the acquisition life cycle via the acquisition strategy. All IPT members and program employees use the AS as a roadmap and guide for direction and purpose. It defines their route toward the end-state and coordinates all actions to ensure a concerted effort by all toward a common goal. Senior leadership and the PM use the AS to communicate goals, objectives, and actions and to develop expectations of overall program performance. The AS contains the procedures for how the program manager will take the program from inception and development through PFDOS and disposal. If MTS is not intertwined as a common thread throughout the entire AS, competing strategies will deteriorate MTS efforts, IPT members will not be aligned on the proper azimuth toward a universal goal of achieving MTS, and opportunities will be lost for MTS to positively influence the management of the program's life cycle costs.

MTS is not an inherent part of PM-LTV's AS. In their Spiral Modernization pillar, MTS is only casually mentioned – as technological improvements are discovered during the system integration and test phase of the pillar, they "...will be integrated into modernized HMMWV production and inserted into the fleet as modifications or Modernization Through Spares initiatives." [Ref. 21] The clear focus of the pillar is modernized HMMWV production with no detail in the AS of how to achieve the MTS initiatives. The only other mention of MTS is in the Other Important Considerations section of their AS. They essentially reiterate the same intent and level of detail for dual use technology insertion into the fleet as MTS initiatives, as they did for technologies discovered during systems integration and test.

Summary of MTS generic tenets. Figure 11 illustrates the degree that the PM-LTV AS meets the generic tenets of MTS. Since no arrows are connecting the tenets with the AS, the figure shows the tenets are not achieved through PM-LTV's AS. Even though PM-LTV uses the IPT process, they lack an IPT with an MTS focus. The HMMWV program did receive a new look but without the necessary MTS flavor. Lastly, PM-LTV did not incorporate MTS with the AS.

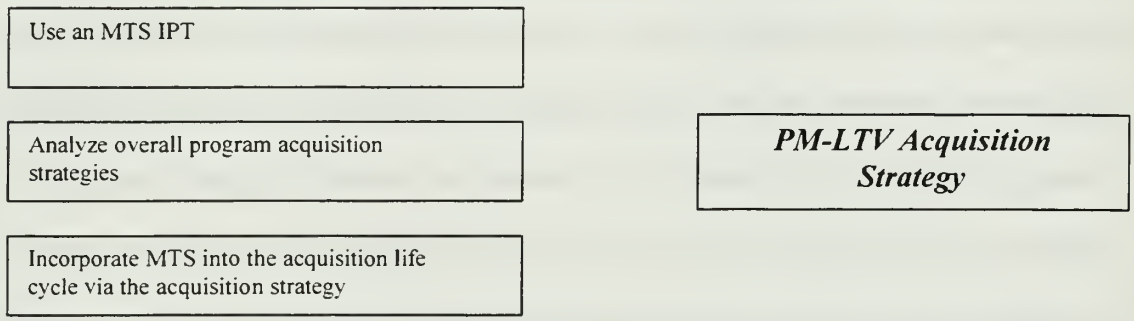

Use an MTS IPT
Analyze overall program acquisition strategies
Incorporate MTS into the acquisition life cycle via the acquisition strategy
PM-LTV Acquisition Strategy

Figure 11. Generic Tenets of MTS and PM-LTV's Acquisition Strategy
[From Data Compiled by Author]

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The following section provides conclusions drawn from the analysis of the Army's MTS implementation strategy compared with the Acquisition Strategy for PM-LTV. The latter sections discuss recommendations for PM-LTV as a result of the analysis and suggest areas for further research.

The Acquisition Strategy for PM-LTV is nothing short of remarkable. The PM-LTV has developed a plan under an adverse and multifaceted set of constraints while meeting several differing objectives. Through a continuing IPT process utilizing the tools of Acquisition Reform, PM-LTV has ensured the warfighter's present and emerging requirements will be met. The end-state of their AS is a modernized HMMWV utilizing recent technologies infused into new production and recapitalized vehicles, extending the useful life of the vehicle by 21 years.

Their creative, three-pronged approach employs techniques and initiatives for modernization of the HMMWV system. Of particular interest is the emphasis on recapitalization to remanufacture a portion of the aging HMMWV fleet because this is where MTS could arguably provide the most benefit to the program. However, little emphasis is placed on utilizing MTS to improve the overall performance of the fleet and reduce O&S costs.

The MTS guidelines and the current AS for the LTV emerged within the same year (please refer to Figure 8). Perhaps the program office did not have adequate time to implement the MTS strategy and amply incorporate MTS into their AS. The working group assigned to conduct the AOA for the Army's LTV was organized and met before

the MTS guidelines were published. Since the AOA results were an integral part of PM-LTV's AS, the AS reflected how the AOA analyses were conducted separately without the benefit of the MTS guide. Had the MTS guide been published earlier or the AOA occurred after the guidelines were published, the AS most probably would have a more distinct and robust MTS presence.

The PM-LTV strategy provides a structure that is not too distant from the MTS strategy suggested by the MTS OIPT. Some of the MTS tenets are met by actions carried out by the AS, although they are not exact replicas of the tenets. Clearly, the focus of their AS is modernization through recapitalization and modernization production, not modernization through spares. However, if the focus was redirected toward spares and the acquisition of spares, many of the same processes and procedures in the AS could easily be transformed in the AS to create an MTS strategy. The current AS reflects procedures to achieve a modernized HMMWV fleet, but it does so without ample MTS attention. Therefore, the AS falls short of the Army's MTS implementation goal.

B. RECOMMENDATIONS

The PM-LTV should fully incorporate the MTS strategy into the PM-LTV AS by referring to the MTS OIPT's guidelines. Their AS currently possesses many of the procedures and actions necessary for successful MTS implementation. Yet without the MTS emphasis well dispersed throughout the AS, the necessary importance and guidance for the conduct of spares acquisition is absent.

An important aspect of MTS implementation is the application of CAIV principles throughout the acquisition life cycle. We recommend that the PM-LTV clarify

the expansion of CAIV principles beyond the "Update ORD" phase of the Spiral Modernization pillar. PM-LTV should dovetail the principles in concert with MTS implementation and reflect the importance of CAIV throughout the AS. Placing a greater emphasis on CAIV principles reinforces the intent to control life cycle costs.

The PM-LTV has to emphasize the use of an open systems architecure – a key enabler of MTS. In the absence of an open systems design, modifications are limited to accepting components, subsystems, or systems that match the form, fit, and function of the piece being replaced. Otherwise, extensive redesign of other components or interfaces affected by the technology insertion that are incompatible would be necessary. The PM-LTV would benefit by more efficient reengineering efforts that focus on technological insertions unconstrained by form, fit, and function.

Along with a greater emphasis on CAIV principles, PM-LTV should articulate the implementing tasks necessary to achieve her objectives (the use of CAIV might be one of the implementing techniques). The end-state of a modernized HMMWV with a concern toward life cycle cost reductions is evident in each of the strategy's pillars. However, implementing tasks for each of the pillars are needed to provide a guiding light for IPT members to follow. Implementing tasks spelled out in each of the pillars funnels effort toward achieving the goals of the AS. Those implementing tasks must also reflect the significance of MTS implementation for technological infusion and cost reduction of spares.

PM-LTV needs to exploit the opportunity to recapture some of the investment dollars utilized while conducting MTS efforts. Any funds reimbursed could be

reinvested to finance the other modernization facets of the AS within the limitations of the appropriations.

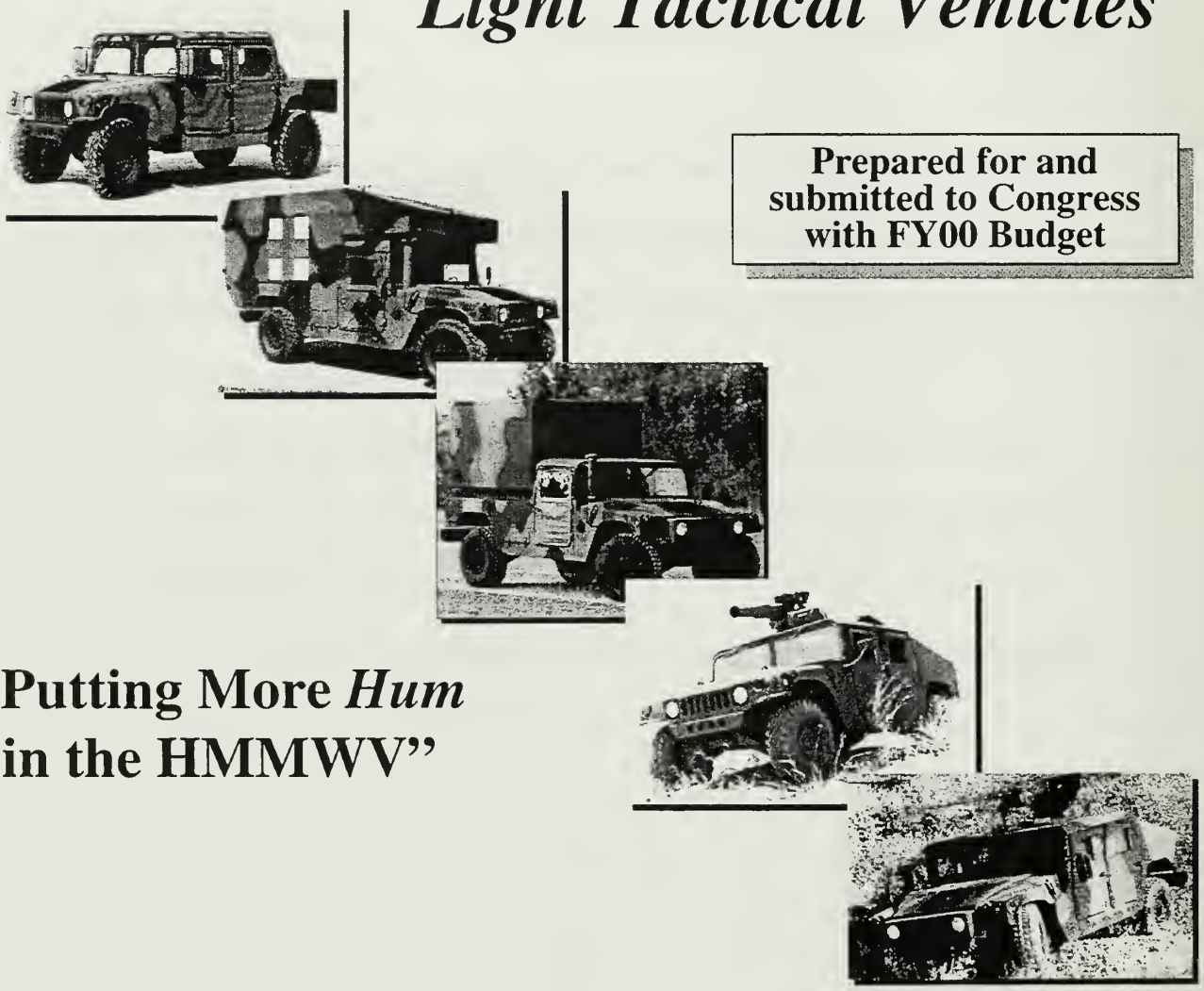
C. AREAS FOR FURTHER RESEARCH

The Army's LTV program and modification techniques it used provide a plethora of opportunities for further research. A few possible research questions to be answered are:

- How do the modernization efforts conducted by PM-LTV compare with other modification strategies such as block upgrades or SLEP?
- Could any of the modernization efforts conducted by PM-LTV be incorporated in the MTS guidelines?
- What other modification techniques should be used in concert with MTS?
- To what extent is MTS implemented in the Army? Are the MTS guidelines utilized? Are they useful?
- How successful has PM-LTV been in implementing their modernization strategy?

APPENDIX A: US ARMY ACQUISITION STRATEGY REPORT FOR LIGHT TACTICAL VEHICLES

US Army Acquisition Strategy Report For Light Tactical Vehicles



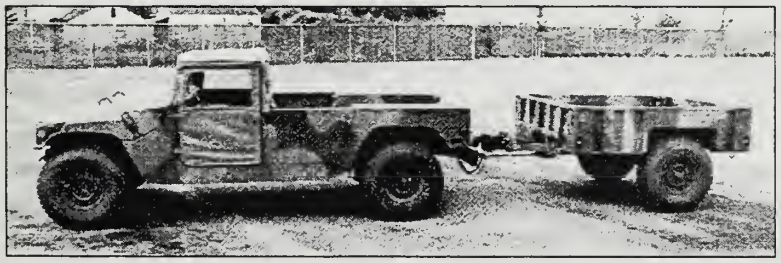
Prepared for and submitted to Congress with FY00 Budget

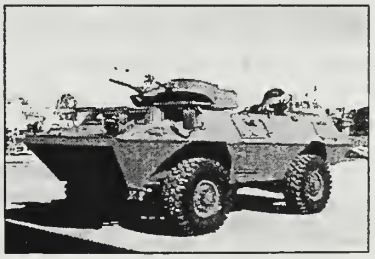
"Putting More *Hum* in the HMMWV"

US Army Tank-automotive and Armaments Command
ATTN: AMSTA-DSA-LT
Warren, MI 48397-5000
http://www.pmltv.com
25 January 1999

PM-LTV Mission

The Project Manager for Light Tactical Vehicles will provide world-class light tactical vehicles to meet the needs of the joint warfighting community. This mission will be accomplished using a customer-focused approach and the following key enablers: an integrated data environment/integrated business environment, cost as an independent variable, leveraging commercial technology and integrated process teams.





Executive Summary

The purpose of this Acquisition Strategy Report (ASR) is to summarize the acquisition strategy for U.S. Army Light Tactical Vehicles (LTV). The term LTV does not refer to a vehicle, but rather a category of vehicles. The U.S. Army Light Tactical Vehicle fleet has been standardized as the High Mobility Multipurpose Wheeled Vehicle (HMMWV). There have been 102,747 HMMWVs procured through Fiscal Year 1998 for the U.S. Army alone, with an Army Acquisition Objective of 121,692.

This strategy is a life cycle management strategy for the fleet of 121,692 HMMWVs. TRADOC has confirmed that this fleet size will not be reduced with the downsizing of the force; in fact, it may increase slightly due to new missions and roles for the light fleet.

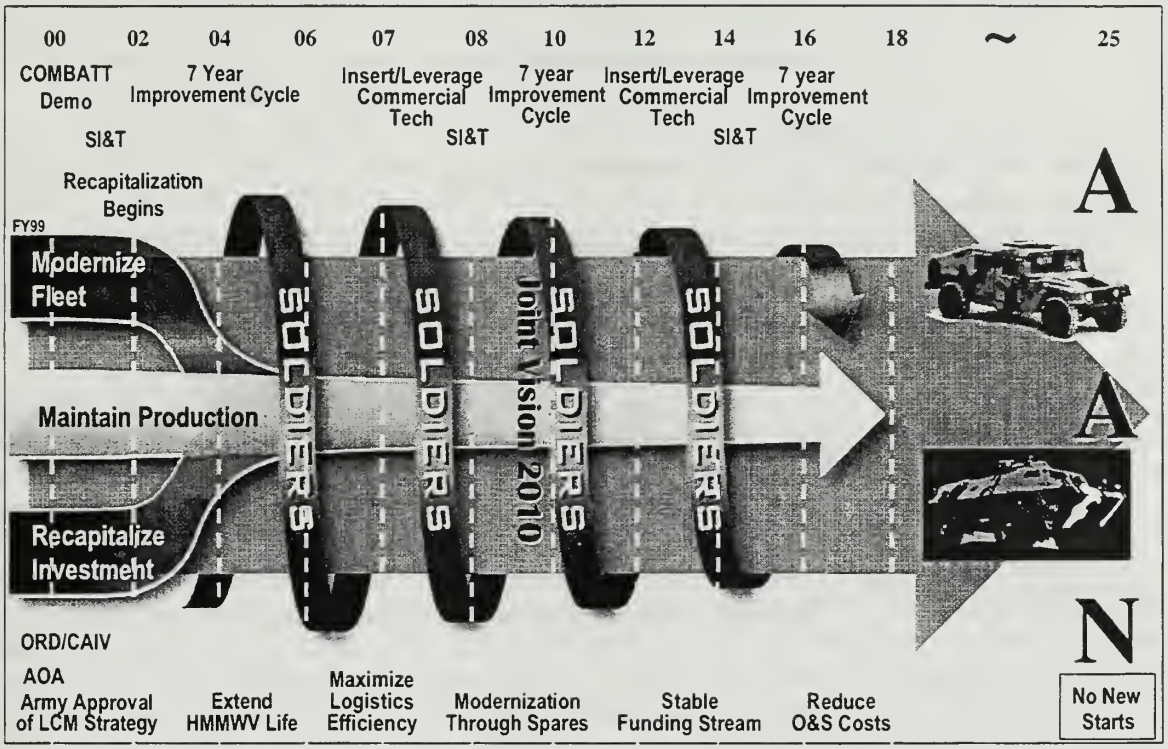
It was envisioned that the HMMWV would be replaced at the end of its Economic Useful Life (EUL) by a new start program called Light Tactical Vehicle (LTV). In 1997, the new start LTV program was cancelled. Congress requested that the Army submit a strategy supported by an Analysis of Alternatives (AOA). A HMMWV AOA was then conducted with preliminary results presented on January 6, 1999 to the Study Advisory Group (SAG). To meet the deadline set by Congress to have a strategy submitted to them with the FY00 budget submission, a joint TACOM/TRADOC Integrated Process Team (IPT) was formed. The PM's strategy evolved concurrently with the conduct of the AOA. PM-LTV, to augment the AOA, did other complementary analyses. From November 1998 to January 1999, a concentrated effort was put forth to explore all feasible alternatives. Emerging AOA results were used by the IPT to formulate the final PM-LTV strategy, ensuring all alternatives were fully considered and that the optimum solution was defined.

In the final analysis, the PM Strategy has not changed significantly from that approved by the TACOM Deputy for Systems Acquisition (DSA) in February 1998. It is still a three-pillar strategy. The three pillars of the strategy are:

1) Modernize the fleet through a spiral modernization cycle of incremental upgrades to the HMMWV design every seven years, accomplished under competitively awarded development contracts, followed by competitively awarded production contracts for the modernized HMMWVs, which achieve the evolving Joint Vision XXI and Army After Next (AAN) requirements;
2) Maintain current production until competition can be generated to develop and produce a modernized HMMWV to meet the needs of Army interchange, Foreign Military Sales (FMS), and other services (i.e., the U.S. Marine Corps (USMC)) at least through FY03, with options to go to FY05;
3) Recapitalize our initial investment in the aging fleet to extend the life of the vehicles by 21 years by using innovative approaches from industry, and leveraging and integrating the technology insertions that become available from the modernization efforts.

The most significant difference in today's PM-LTV Strategy versus the February 1998 strategy is the shift from the Hybrid-Remanufacturing concept, with its target of providing an

additional six years of service life, to the Recapitalization concept which, through a broader, more flexible range of repair, targets an additional 21 years of service life. Only the expanded scope of the Recapitalization concept provides the opportunity to replace corroded and structurally weakened frame rails with a design incorporating a more advanced corrosion protection package. This expanded scope, addressing the vehicle frame rails, is critical to achieving an additional 21 years of service life. This is a significant change to this portion of the strategy, which is based on the results of the AOA. The AOA indicated a significant potential cost avoidance by adopting this approach over Hybrid-Remanufacturing due to reduced number of refurbishment cycles required to achieve the same increase in years of extended service life.



Spiral modernization is possible due to the fact that the HMMWV is a world-class system that maintains overmatch capabilities essential to our warfighters. These capabilities can be met by no other vehicle in this class today. Therefore, incremental improvements over a span of 21 years are considered adequate to meet the user's needs. Due to the limitations of corrosion protection methods, extending the life of a light vehicle beyond 21 years is questionable. The modernized HMMWV will be competed using a performance specification, with the HMMWV TDP provided for reference to encourage commonality. PM-LTV and TRADOC are working together using Cost As an Independent Variable (CAIV) to evolve the HMMWV ORD requirements and develop an affordable performance specification. As one of the IPT members said: "We are putting more Hum in the HMMWV!" The result will be a High Mobility Multipurpose *Modernized* Wheeled Vehicle (HMM*M*WV) in order to distinguish it from its predecessor.

PM-LTV used the following guidance, received from the Army Acquisition Executive (AAE), high level Department of the Army (DA) executives, and General Officers in formulating this strategy:

- No new start program
- No "leap ahead" capability requirements exist, now or in the near future
- HMMWV is the basic light tactical vehicle for Army XXI
- Fleet is aging; however, must meet Army needs until AAN
- Leverage commercially available technology
- Introduce competition, none exists today
- Work within the existing budget
- Provide a 100% solution for maintaining fleet readiness
- Look at alternatives to mandatory replacement of vehicles reaching their EUL
- Evaluate the HMMWV EUL
- Support Joint Vision XXI and Army XXI goals
- Support AAN goals
- Maintain overmatch capability consistent with the needs of the maneuver force
- Maintain performance at least as good as the performance of the fleet today
- Do not increase Operations and Support (O&S) costs
- Look at extending the life of the HMMWV
- Support the AOA conducted by TRADOC Analysis Center-Ft. Lee (TRAC-Lee)
- Consider all alternatives
- Support the USMC replacement strategy; they are our partners
- Deliver an Army-approved Acquisition Strategy, supported by the AOA, by 30 Jan 99

Working through this difficult and complex problem, PM-LTV and the IPT developed the strategy detailed in this document, which contains a solution meeting all of the above elements and balances all the known requirements from a systems perspective. PM-LTV made two key assumptions in building this strategy: (1) The Acquisition Category level will remain ACAT III; and (2) an adequate and stable funding stream will be established and maintained to support its execution.

The essence of this strategy is that it extends the life of the HMMWV (to 21 years) to meet the mission requirements, while minimizing the impact on the funding requirements in the Program Objective Memorandum (POM); eliminates the spikes in procurement dollars required; and creates a stable level of funding as well as sound execution strategy over the life cycle of the fleet. It also enables a more gradual and stable strategy for a future system, should it become needed to meet AAN requirements in 2025.

PM-LTV believes this strategy offers the lowest cost solution given today's requirements. Although there is an anticipated increase in O&S costs in the existing fleet until all vehicles can be modernized or recapitalized, this burden is difficult to quantify and substantiate. Predictions, however, forecast that vehicles could remain in the field ten additional years before O&S costs accumulate beyond the acquisition cost to replace the vehicles. Due to the large fleet size and the objective to keep the budget to a minimum, some of the current HMMWVs will remain in the

fleet up to 36 years under this strategy. PM-LTV will employ a fleet management strategy as part of the Recapitalization program that strives to recapitalize all vehicles before their cumulative O&S costs, after year 15, exceed the cost of acquiring a new vehicle. PM-LTV also believes that the modernized HMMWV portion of this strategy offers the most affordable means to mature commercial technology, make it available, and leverage the commercial production base to satisfy the Army XXI ORD requirements.

This strategy defines broad concepts, timelines, milestones, and resources which, when executed, will result in the most cost effective Life Cycle Management of the HMMWV fleet. The detailed content of the Modernization and Recapitalization plans and contracts will be determined through comprehensive engineering and cost analyses employing progressive analytical tools. These efforts are underway, concurrent with efforts to refine the ORD requirements, and will proceed according to the program schedule.

This strategy is built on collaborative efforts of many DA organizations and with the participation of the USMC, Marine Corps Systems Command (MARCORSYSCOM). Led by PM-LTV, numerous organizations pulled together in the true spirit of an IPT to accomplish the AOA, other complementary analyses and thinking adventures, and to innovate the best strategy to provide adequate readiness at the lowest possible life cycle cost. Please accept my special thanks to all those who supported this effort.

This document is fully coordinated within the U.S. Army and was approved by the U.S. Army Acquisition Executive on January 25, 1999. Concurrences on the PM-LTV Strategy include the following: Director of Strategic and Tactical Land Systems, Office of the Secretary of Defense; Deputy Assistant Secretary of the Army for Procurement; Deputy Assistant Secretary of the Army for Systems Management and Horizontal Integration; Assistant Deputy Chief of Staff for Force Development; Deputy Asssistant Secretary of the Army for Plans, Programs and Policy; Director of Assessment and Evaluation; and the Commanding General, U.S. Army Tank-automotive and Armaments Command (TACOM).

NANCY A. MOULTON
Project Manager, Light Tactical Vehicles

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I. Introduction

This document defines the Project Manager, Light Tactical Vehicle's (PM-LTV) strategy for executing Life Cycle Management of the High Mobility Multipurpose Wheeled Vehicle (HMMWV) fleet. This strategy was developed at the direction of Congress. It builds on the data and conclusions presented in the AOA conducted by the U.S. Army Training and Doctrine Command (TRADOC), also at the direction of Congress.

> *"... the Committee directs that the Secretary of the Army submit a light tactical wheeled strategy with the fiscal year 2000 budget. The plan is to include the requirements, estimated development and acquisition costs, and estimated operation and support costs for each alternative."* [1]

Given the realities of budget constraints and the Army leadership decision not to pursue a "new start" program for the Light Tactical Vehicle, this strategy details the most cost effective approach to meeting the Army's light vehicle mission requirements through Force XXI. It utilizes a three pillar concept consisting of (a) maintaining current production, (b) modernizing the design for future production, and (c) recapitalizing existing fleet assets.

This strategy does not rely on "leap ahead" technologies and, therefore, is not jeopardized by the inherent risks to cost and schedule that such an approach presents. It does require a constant and realistic funding stream to prevent fleet aging and mileage from overwhelming the Army Operating and Support (O&S) budget and expanding mission requirements from outpacing fleet capabilities.

The light vehicle requirements for the Army After Next (AAN) are now just emerging. It is unlikely that they could be met by even an enhanced HMMWV design. Should that prove to be the case, a "new start" program employing "leap ahead" technology would be required. This strategy is designed to service the Army light tactical truck missions until that time.

[1] House of Representatives, Report 105-532; 105th Congress. 2d Session: May 12. 1998; Pg. 112.

II. Requirement

A. Joint Mission Element Need Statement

The HMMWV Joint Mission Element Needs Statement (JMENS) described a multi-service requirement for a vehicle platform capable of transporting payloads from 1/4 to 5/4 tons and adaptable to combat, combat support, and combat service support missions. Six primary functional objectives were established which included mobility/agility, payload, survivability, transportability, logistics (emphasis on commonality), and training. The JMENS was approved by the Deputy Secretary of Defense in July 1980. Included in the approval was the exemption of the HMMWV program from Defense System Acquisition Review Council (DSARC) procedure, and assignment of the program to the Department of the Army for execution.

The JMENS was amended in December 1989 to establish the requirement for the "heavy HMMWV," which increased the payload, towed load, and transportability performance criteria over the original model.

In 1990, the Army approved an addendum to the JMENS for a modification kit for the M1025 and M1026 HMMWV. This modification satisfies mission requirements of scout units in heavy maneuver battalions by increasing reconnaissance/target acquisition, communications, and reporting capabilities.

The JMENS was again amended in September 1993 to establish the requirement for the "Up-Armor HMMWV," which addresses the increased ballistic protection needed to support reconnaissance and military police missions.

B. HMMWV Operational Requirements Document

In March 1996, the Army Deputy Chief of Staff for Operations (DCSOPS) requested that TRADOC review, consolidate, and revise the JMENS and issue a light tactical vehicle Operational Requirements Document (ORD). In May 1997, TRADOC released a draft Light Tactical Vehicle (LTV) ORD for world-wide staffing. During the summer of 1997, the Army Vice Chief of Staff withdrew support for the LTV new start Program. TRADOC released a draft "HMMWV II" ORD in December 1997. The draft release, dated 20 October 1998, was used as the basis for conducting the AOA. PM- LTV is assisting in the refinement of the ORD through the application of cost/benefit analyses and Cost As An Independent Variable (CAIV) techniques targeted at the establishment of realistic thresholds and objectives. The target date for the release of the final ORD is March 1999.

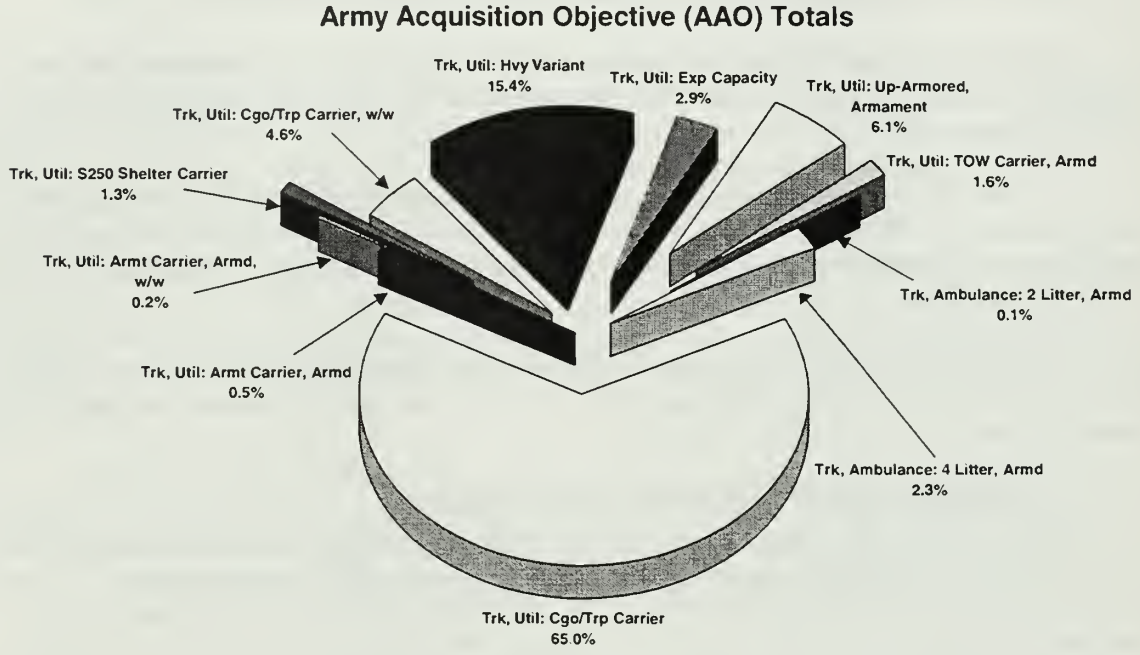
C. Pure Fleet

In 1990, the DCSOPS directed that all units below Corps level be "pure fleeted" with the HMMWV due to the limited mobility of the Commercial Utility Cargo Vehicle (CUCV). In 1996, the DCSOPS directed that the entire light fleet be "pure fleeted" with the HMMWV.

D. Crew Protection Kit Operational Requirements Document

The Crew Protection Kit (CPK) ORD was approved by TRADOC in January 1990. It defines the requirement for increased crew protection for tactical wheeled vehicles, where needed, while operating throughout the area of operation. The CPK will provide protection for the crew against small arms fire, artillery/mortar fire, mines, submunitions, and improvised explosive devices. The kit design concept focuses on the protection of the individual crew members as opposed to the entire crew compartment, and provides flexibility in the level of protection dependent upon the threat.

E. Army Acquisition Objective


Army Acquisition Objective (AAO) Totals
Trk, Util: Hvy Variant 15.4%
Trk, Util: Exp Capacity 2.9%
Trk, Util: Up-Armored, Armament 6.1%
Trk, Util: Cgo/Trp Carrier, w/w 4.6%
Trk, Util: TOW Carrier, Armd 1.6%
Trk, Util: S250 Shelter Carrier 1.3%
Trk, Util: Armt Carrier, Armd, w/w 0.2%
Trk, Ambulance: 2 Litter, Armd 0.1%
Trk, Util: Armt Carrier, Armd 0.5%
Trk, Ambulance: 4 Litter, Armd 2.3%
Trk, Util: Cgo/Trp Carrier 65.0%

The current AAO calls for the procurement of 121,692 HMMWVs of various models. This figure represents the combined total of Table of Organization and Equipment (TO&E), Table of Distribution and Allowances (TDA), and Interchange Customer requirements.

F. Legislative Requirements

In addition to the operational requirements, vehicle design is governed by federal regulations:

- Federal Motor Vehicle Safety Standards (FMVSS)
- Federal Motor Carrier Safety Regulations (FMCSR)
- Environmental Protection Agency emission standards

III. Strategy Development

A. Process, Timeline, Concurrent Development

This HMMWV acquisition strategy is the result of considerable effort by the entire tactical vehicle community over several years to determine the best course or action to support the Army's light truck needs for Force XXI. Unlike many other programs that proceed in a more linear manner in their development of concepts and analysis of alternative solutions, the current HMMWV program has proceeded on multiple concurrent paths. First, the Army initiated an Analysis of Alternatives, described below, to help clarify options for the HMMWV fleet. Second, the PM-LTV must plan to support an increasing number of HMMWVs approaching 15 years of age considering economic, operational, and engineering useful life. Third, the budget process requires input to ensure that funds will be available to support the acquisition strategy. This section describes the historical basis for this acquisition strategy and the concurrent events affecting it.

B. Analysis Of Alternatives

The AOA is an independent analysis which indirectly challenges the ORD requirements by determining which study alternative is the most cost and operationally effective. AOA findings provide analytic underpinning to support a recommendation and decision to continue further development of the programmed system. The AOA is not prepared to specifically support the programmed system described in the ORD. The analysis results assist the Milestone Decision Authority (MDA) to decide whether the programmed system should continue. If conditions warrant, the MDA may direct updates to the AOA for subsequent decisions.[2] The HMMWV AOA was prepared to provide the MDA and PM-LTV the analysis on which to build a high quality program strategy, which is required to be submitted to Congress with the Army's budget no later than 30 January 1999.

1. Background

The initial AOA began with a recognition by the Army that new and improved automotive technologies were appearing in commercial vehicles and that use of these technologies could enhance HMMWV performance and readiness, as well as reduce O&S costs.[3] In December 1996, the Army tasked TRADOC to conduct an AOA and consider alternatives that included procuring a new light tactical vehicle (new start) to meet ORD requirements.

A SAG was formed to control, direct, and review study efforts. It was chaired by the Assistant DCSOPS for Force Development and by the Director for Assessment and Evaluation, Office of the Assistant Secretary of the Army (Research, Development & Acquisition). SAG members were:

- Deputy Under Secretary of the Army (Operations Research)
- Technical Advisor to the DCSOPS

[2] TRADOC Pamphlet 71-9, Force Development, paragraph 9-3.
[3] Message, DAMO-FD/SARD-ZD, 221759Z Nov 96, HMMWV II Analysis of Alternatives.

- Deputy Director of Program Analysis and Evaluation
- Commander, U.S. Army Tank-automotive and Armaments Command (TACOM)
- Senior representative from TRADOC

Subsequently, the U.S. House Appropriations Committee (HAC), in its review of the FY98 budget, directed the Army to provide a report by 15 September 1997 outlining the lightweight tactical vehicle alternatives which the Army planned to evaluate. The report was to include the requirements, estimated development and acquisition costs, and estimated O&S costs for each alternative.

2. HMMWV Family Life Cycle Management IPT

In December 1997, the TACOM Deputy for Systems Acquisition (DSA) chartered an IPT to develop a fleet management plan for the HMMWV fleet through FY12. IPT objectives included the following:

- Implement and integrate Total Life Cycle Fleet Management requirements as developed by the group based on statutory, regulatory, and program requirements.

- Accelerate the development of a HMMWV Family of Vehicles Fleet Management Plan as a living document.

- Resolve cost, schedule, performance, and supportability problems.

Working groups were formed to study current fleet status, modernization alternatives, and sustainment issues. The modernization working group had members from across TACOM and was headed by PM-LTV. The working group developed alternatives for continuing HMMWV production, remanufacturing older vehicles, and buying commercial vehicles.

In February 1998, these alternatives were briefed to the TACOM DSA, who used them to initiate a conceptual LTV acquisition strategy consisting of continued production of HMMWVs for interchange customers, procurement of a new HMMWV-like vehicle from either a military or commercial vehicle manufacturer, and a hybrid-remanufacturing program to include Inspect and Repair Only As Necessary (IROAN) criteria and some equipment improvements. This strategy did not recommend funding beyond what was in the budget and did not support improvements to more than approximately 22% of the HMMWV fleet. In August 1998, this strategy was briefed to the AAE, who directed the strategy be expanded to support the AAN program and improve all of the HMMWV fleet.

3. Commercially Based Tactical Truck

While developing the conceptual strategy, the National Automotive Center (NAC) Commercially Based Tactical Truck (COMBATT) program gained the interest of the TACOM DSA and other Army leadership as a way to add commercial involvement to the conceptual LTV acquisition strategy. The NAC participated in the HMMWV Life Cycle IPT modernization working group and a notional COMBATT-type commercial truck was included in an alternative. Section IV.C.2. describes the COMBATT program in more detail.

4. Current AOA

In the summer of 1997, Army support for a new start LTV program diminished and the AOA effort was put on hold. In December 1997, the AOA effort was redirected based on new guidance from the Army leadership, which redefined the alternatives, eliminating a new start.

Following the redirection of the AOA, a working group formed in February 1998 with representatives from TRADOC Analysis Center (TRAC)-Lee, TRAC-White Sands Missile Range (WSMR), Army Materiel Systems Analysis Activity (AMSAA), TACOM Fleet Planning Office, and PM-LTV. Additional assistance came from DCSOPS, Office of the Assistant Secretary of the Army (Research, Development and Acquisition (OASA(RDA)), U.S. Army Cost and Economic Analysis Center (CEAC), and the TRADOC System Manager for Tactical Wheeled Vehicle Modernization (TSM-TWVM). The working group developed and refined the alternatives into the following (See Appendix D for details):

Alternative 1. Conduct an Extended Service Program (ESP)

Alternative 2A. Procure a Modernized HMMWV. The study did not quantify improvements in vehicle performance.

Alternative 2B. Procure a Commercial Vehicle. This alternative would procure commercial trucks, such as might result from the COMBATT program, for standard and shelter carrier roles. In addition, the RG-31 Nyala mine-protected vehicle was included for the armament carrier role.

Alternative 3. Conduct a Hybrid-Remanufacture Program. This tailors and expands the IROAN concept to include technology insertion, application of open Modification Work Orders (MWO), safety improvements, and other vehicle improvements determined to be affordable under a cost cap of one-half the cost of a new HMMWV.

Alternative 4. Procure a Combination of Alternatives – June 1998 PM strategy. This alternative represented the concept of the three-pillared HMMWV acquisition strategy. It included continued HMMWV production for Army interchange and other service customers, a modernized HMMWV for Force Packages 1 and 2, and a hybrid-remanufacturing program to extend the life of HMMWVs in Force Packages 3 and 4.

Alternative 4. Procure a Combination of Alternatives – December 1998 PM Strategy. This alternative was developed as emerging AOA results indicated that Alternative 4 – June 1998 PM strategy was less affordable than was earlier believed. This alternative differed from June 1998 version in that the hybrid-remanufacture pillar was replaced by a recapitalization pillar to allow for more extensive improvements and, most importantly, providing the opportunity to replace corroded and structurally weakened frame rails. By expanding the scope to include replacement of frame rails with an advanced corrosion prevention package, it is feasible to extend the useful life to 21 years.

Excursion 1. Procure an Existing Army Vehicle. This excursion uses the Light Medium

Tactical Vehicle (LMTV) for shelter carrier roles and the XM1117 Armored Security Vehicle (ASV) for armament carrier roles.

In the summer of 1998, the HAC again requested the Army submit a light tactical wheeled vehicle strategy with the Army's FY00 budget. In the same period, the Senate Appropriations Committee directed the Army to evaluate the John Deere GATOR and its potential to meet future light vehicle requirements. The GATOR is a six wheel, four wheel drive light utility tractor offered by Deere & Company to support maintenance of golf courses and other large lawn turf areas. The GATOR analysis was included in the AOA as an annex.

The Study Director briefed AOA progress to the SAG in June 1998. A significant outcome of the briefing was an increased emphasis on developing the analytical foundation for AOA assumptions about military vehicle EUL. The TACOM Fleet Planning Office reviewed existing data and expanded their ongoing EUL analysis. Their work resulted in an adjustment (for AOA purposes) from 14 to 15 years for HMMWV EUL. In December 1998, preliminary AOA results were prepared for the SAG and a final report is planned for March 1999.

In January 1999, the Study Director briefed the SAG on preliminary results of the AOA. The SAG agreed with the general results and methodology of the AOA. In addition, TRADOC was requested to consider a potential mix of military and commercial vehicles as an excursion similar to Excursion 1 (described above in the AOA alternatives). TRADOC was also requested to reconsider the ORD Key Performance Parameters (KPP) to simplify them and reduce their number.

C. Analysis of Results

PM-LTV analyzed the AOA preliminary results to determine whether Alternative 4-December 1998 Strategy was the best choice among the alternatives. Subsequent to selecting Alternative 4, the PM-LTV IPT further enhanced the strategy to extend the service life goal to 21 years and to establish an objective to cap the cost of Recap to 60% of the cost of a new modernized HMMWV. Following is the result of the PM-LTV assessment of the AOA alternatives and rationales for the decisions made for this acquisition strategy. The AOA alternatives involving single actions (1, 2A, 2B, 3, Excursion 1) were eliminated because, by themselves, they did not affect enough of the entire HMMWV fleet. Alternatives 4 – June 1998 and 4 – December 1998 are combinations of the other single action alternatives and offer much more benefits to the entire fleet.

Base Case – used only as a basis for comparison.

- Does not meet Army requirements for Force XXI.
- It assumes that new vehicles are never purchased once the AAO is reached.

Alternative 1 (ESP) – eliminated.

- ESP alone cannot meet ORD requirements.
- Digitized Army requirements not met.
- Joint Vision XXI, Army XXI and AAN objectives not met.

Alternative 2A (Improved HMMWV) – eliminated

- Best alternative with greatest potential to meet ORD requirements.
- Best alternative to meet Joint Vision XXI, Army XXI and AAN objectives and evolving requirements.
- Best alternative for potential O&S cost reductions.

Alternative 2B (Commercial Truck) – eliminated

- Commercial truck alone cannot meet ORD requirements.
- Crew protection kit and armament mission high risk.
- Shelter Carrier medium risk.
- Mixed fleet option for standard mission to be evaluated.

Alternative 3 (Hybrid-Remanufacture) – eliminated

- Hybrid-Remanufacture alone does not meet ORD requirements.
- Digitized Army requirements not met.
- Joint Vision XXI, Army XXI and AAN objectives not met.
- Minimal technology insertion; minimal O&S cost reduction.
- High risk; assumes multiple reman cycles for same vehicle.

Alternative 4 (June 1998 PM Strategy) – eliminated

- Has same potential to meet requirements as Alternative 4 (Dec 98).

Excursion 1 (LMTV and Armored Security Vehicle (ASV) in Certain Roles) – eliminated

- Does not meet critical transportability and mobility requirements in ORD.
- Offers good alternative for mission capability.
- O&S costs are much higher.

Alternative 4 - December 1998 PM Strategy – selected

- Spiral Modernization cycles allow improvements to meet ORD requirements over time through new production.
- Current production is maintained until the first competitive Spiral Modernization contract can be awarded.
- Recapitalization lowers cost of ownership and integrates technology insertions to meet only critical needs.
- Assumes a burden of O&S costs for vehicles beyond 15 years.
- Targets lowest level quantities and stretched out production to FY25 to meet AAN.
- Assumes service life goal to 21 years due to 22-year corrosion protection potential.

Parallel efforts by PM-LTV and TRADOC determined that:

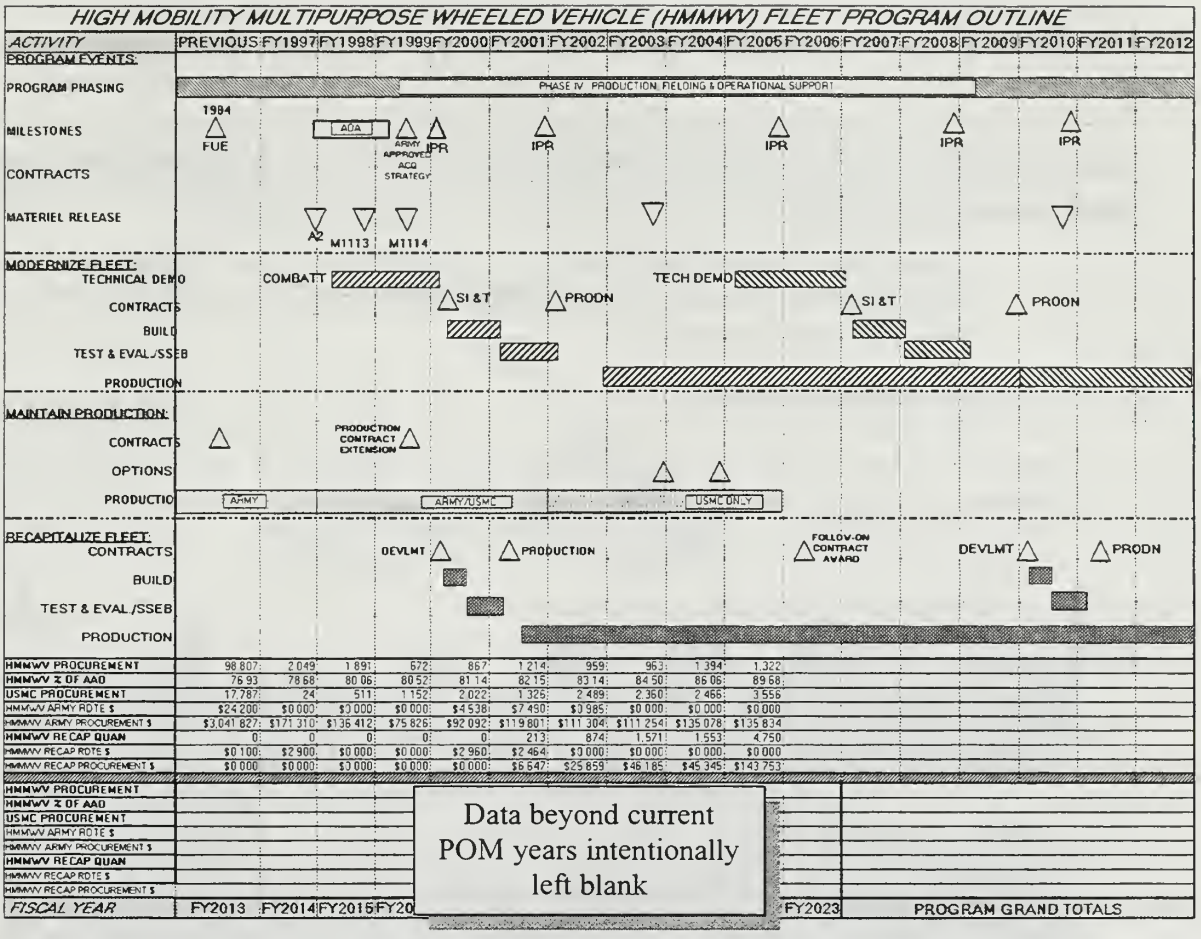
- The Improved HMMWV is the only alternative that has the potential to meet ORD requirements for Force XXI.
- The Commercial Truck, LMTV, and ASV alternatives are not acceptable to Army users because they do not meet critical mobility and transportability requirements.

- Recapitalization should be pursued only if there is insufficient funding to buy only Improved HMMWVs.
- Recapitalization can lead to a significant cost avoidance when compared to other alternatives.

The remainder of this document describes the strategy that PM-LTV intends to implement to take the HMMWV fleet into the future to support Force XXI and AAN.

IV. Program Structure

A. Program Status


HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV) FLEET PROGRAM OUTLINE
ACTIVITY
PREVIOUS FY1997 FY1998 FY1999 FY2000 FY2001 FY2002 FY2003 FY2004 FY2005 FY2006 FY2007 FY2008 FY2009 FY2010 FY2011 FY2012
PROGRAM EVENTS:
PROGRAM PHASING
PHASE IV PRODUCTION, FIELDING & OPERATIONAL SUPPORT
MILESTONES
1984
FUE
ADA
ARMY APPROVED ACQ STRATEGY
IPR
IPR
IPR
IPR
IPR
CONTRACTS
MATERIEL RELEASE
A2
M1113
M1114
MODERNIZE FLEET:
TECHNICAL DEMO
COMBAT T
SI &T
PRODN
TECH DEMO
SI &T
PRODN
CONTRACTS
BUILD
TEST & EVAL/SSEB
PRODUCTION
MAINTAIN PRODUCTION:
CONTRACTS
PRODUCTION CONTRACT EXTENSION
OPTIONS
PRODUCTIO
ARMY
ARMY/USMC
USMC ONLY
RECAPITALIZE FLEET:
CONTRACTS
DEVLMT
PRODUCTION
FOLLOW-ON CONTRACT AWARD
DEVLMT
PRODN
BUILD
TEST & EVAL /SSEB
PRODUCTION
HMMWV PROCUREMENT 98 807 2 049 1 891 672 867 1 214 959 963 1 394 1,322
HMMWV % OF AAO 76 93 78 68 80 06 80 52 81 14 82 15 83 14 84 50 86 06 89 68
USMC PROCUREMENT 17 787 24 511 1 152 2 022 1 326 2 489 2 360 2 466 3 556
HMMWV ARMY RDTE $ $24 200 $0 000 $0 000 $0 000 $4 538 $7 450 $0 985 $0 000 $0 000 $0 000
HMMWV ARMY PROCUREMENT $ $3,041 827 $171 310 $136 412 $75 826 $92 092 $119 801 $111 304 $111 254 $135 078 $135 834
HMMWV RECAP QUAN 0 0 0 0 213 874 1,571 1,553 4,750
HMMWV RECAP RDTE $ $0 100 $2 900 $0 000 $0 000 $2 960 $2 464 $0 000 $0 000 $0 000 $0 000
HMMWV RECAP PROCUREMENT $ $0 000 $0 000 $0 000 $0 000 $0 000 $6 547 $25 659 $48 185 $45 345 $143 753
HMMWV PROCUREMENT
HMMWV % OF AAO
USMC PROCUREMENT
HMMWV ARMY RDTE $
HMMWV ARMY PROCUREMENT $
HMMWV RECAP QUAN
HMMWV RECAP RDTE $
HMMWV RECAP PROCUREMENT $
Data beyond current POM years intentionally left blank
FISCAL YEAR
FY2013 FY2014 FY2015 FY20
FY2023
PROGRAM GRAND TOTALS

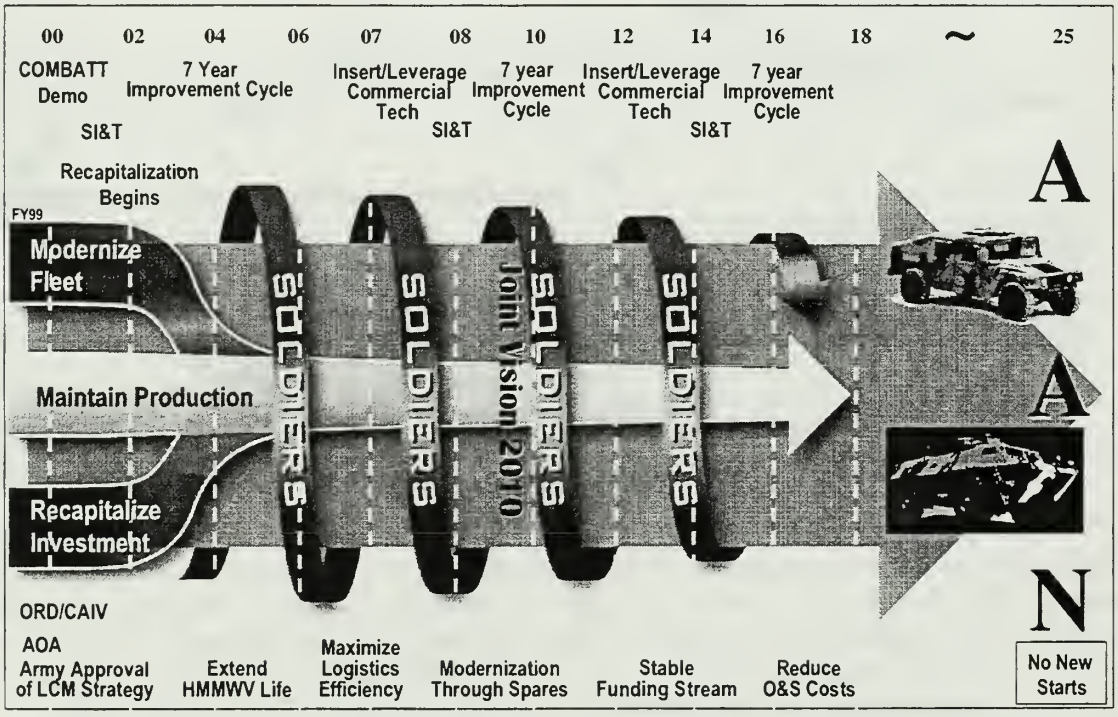
The HMMWV program was originally designated as a "non-major" system and was delegated to Headquarters Department of the Army (HQDA) for In Process Review (IPR) approval. IPR approval was granted in February 1983 and the production contract was awarded in March 1983. The program is currently in Phase III (Production and Deployment). Since the award of the initial production contract through FY99, 136,145 units will have been produced; 103,419 for Army and the remainder for the United States Air Force (USAF), USMC, and Foreign Military Sales (FMS). HMMWV production continues under a fixed price, five year requirements contract with AM General.

B. Program Focus

The PM-LTV plans to implement a three pillar strategy to support the Army light tactical vehicle requirements:

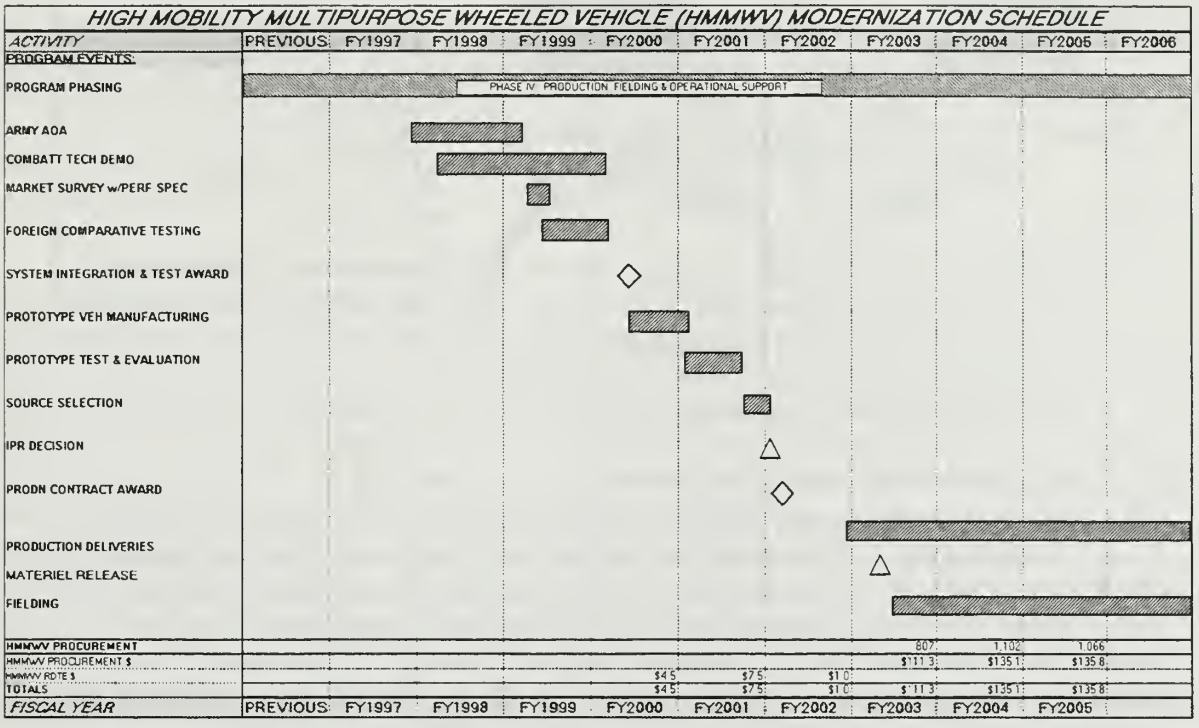
- Modernize: Leverage advancements in commercial and military truck technology for insertion in the HMMWV fleet which increase system performance to more closely achieve ORD requirements and reduce O&S costs. Improved technologies developed and tested under an R&D effort will be integrated into modernized HMMWV production and inserted into the fleet as modifications or Modernization Through Spares initiatives.
- Maintain Production: Continue to fill shortages within the AAO, to the extent allowed by budget, and satisfy requirements for interchange customers, other services, and foreign sales until a modernized HMMWV can be put into production. This will be accomplished by continuing HMMWV production under the existing Firm Fixed Price (FFP) contract with an extension at least through FY03 with options through FY05.
- Recapitalize: Extend fielded vehicle service life and reduce O&S costs of the HMMWV fleet through the establishment and execution of a HMMWV Recapitalization program.

C. Spiral Modernization



The Spiral Modernization pillar of our strategy will concentrate in a cyclic manner to meet the current and emerging requirements for the HMMWV fleet through technical insertions into the HMMWV program. With each cycle, HMMWVs will be produced that more fully meet the Light Tactical Vehicle requirements of FORCE XXI doctrine as identified in the ORD. The HMMWV represents a mature design which requires considerable revision to meet those requirements in an affordable manner both from the acquisition and operational support standpoint. It is our intent to accomplish incremental improvement cycles of seven years by (a)

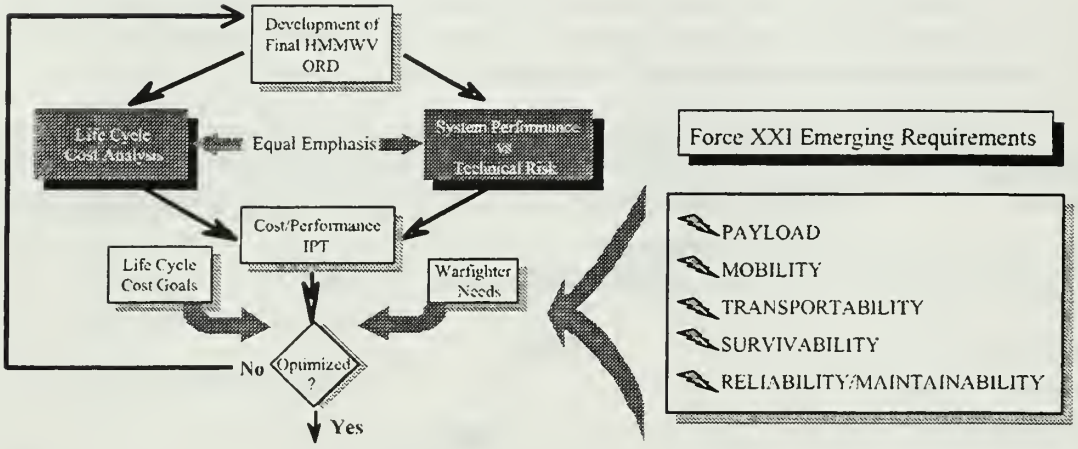
defining the near term technologies available, (b) re-evaluating the operational requirements through the ORD/CAIV process, (c) through a System Integration & Test (SI&T) phase, validating and testing those technologies and incorporating them into the HMMWV in the most cost effective manner possible. The result will be a Modernized HMMWV that is capable of satisfying the Joint Vision XXI requirements. Under this strategy, the HMMWV will continue to evolve over time to meet AAN requirements at a reduced cost by developing, encouraging, and leveraging commercially available technologies. This is depicted in the summary diagram and will be expanded upon in the following paragraphs.



1. Operational Requirements Document Update

The updated ORD is intended to articulate thresholds that focus on reflecting realistic requirements for today's fleet and objectives that reflect the requirements necessary to meet projected Force XXI requirements. Program risks associated with this strategy being applied to the existing HMMWV are that KPPs may not allow sufficient flexibility to meet cost objectives. There is the risk that without careful consideration, interrelated requirements will result in actual physical impossibilities. Components planned for FORCE XXI, and developed by independent project managers, may not integrate onto a HMMWV platform. The desired incremental protection levels (Crew Protection Kits) for all vehicle models are a significant challenge to integrate on the existing HMMWV platform. We are mitigating this risk through close cooperation with the Combat Developer using an IPT approach in review of the current iteration of the document. They have agreed that CAIV principles should be applied. Currently a Cost/Performance Trade-off IPT is identifying the costs and risks associated with the performance thresholds and objectives.

Cost As an Independent Variable
Cost Benefit Analysis Process



2. Technology Demonstration

a. Commercially Based Tactical Truck

PM-LTV is participating with the NAC to leverage the commercial marketplace and through a cost sharing relationship develop dual use technologies for militarized commercial components. This will be demonstrated by incorporating the technologies in modified Ford F350. Dodge RAM and AM General HMMWVs. These are aimed at demonstrating the feasibility of obtaining HMMWV-like performance for selected ORD requirements as well as providing technology insertions into the HMMWV program. This program is scheduled to be completed in FY99 and will dovetail into the HMMWV modernization schedule

b. Foreign Comparative Testing

Currently, the HMMWV clearly is the world leader in light payload, tactical vehicles. However, recently, companies from other countries have introduced vehicles that offer mobility approaching HMMWV capability. PM-LTV plans to pursue a foreign comparative testing program, concurrent with, and in collaboration with, the COMBATT program, to encourage foreign competition during the competitive selection process leading to the award of the development contract. The PM-LTV is coordinating with the National Ground Intelligence Center, TACOM, and the Foreign Comparative Testing (FCT) Office to arrange for funding to acquire and test foreign equivalents to the HMMWV. The FCT program for the HMMWV will begin in FY99 and will be completed in FY00 with a comparative test of foreign sourced light tactical vehicles against the HMMWV ORD KPPs.

3. System Integration & Testing

SI&T for the modernization plan for HMMWV will commence with Research,

Development, Test & Evaluation (RDT&E) funding starting in FY00 through FY02. This Phase will be used to develop and validate potential technology insertion initiatives that are directly linked to ORD requirements or to O&S cost savings from a systems perspective. Specific O&S areas to be incorporated include corrosion prevention, electronics, digital data bus, suspension and integration of the HMMWV with other components on the Digital Battlefield. ORD requirements that involve O&S areas include maintainability requirements, maximum maintenance man-hours per operating hour, and durability. ORD performance upgrades require the heavier variants to have similar performance and mobility as the current lighter versions. Towed load allowances are increased. Efforts will be made to create a system that allows more seamless integration as the highest density vehicle on the digital battlefield to provide a "plug & play" type adaptable combat platform for various mission critical joint task force systems. Technologies evaluated during this phase will also be considered from incorporation into the existing fleet through incorporation in the Recapitalization scope or Modernization Through Spares initiative to the maximum extent practicable given technical and economic considerations.

There will be a concerted effort to control acquisition costs by fostering competition. Prior to initiation of this phase concurrent with the ORD finalization and approval process, formal market surveys will be conducted to help determine the possibility of system level competition. The configuration of the modernized HMMWV will be controlled by the performance specification with the current Technical Data Package (TDP) provided as a reference document. The market survey will include the draft system performance specification reflecting the ORD. This is not a new start process. The existing HMMWV will be the baseline for configuration changes made to meet the specification requirements. While there is informal information that competitive interest exists there is a significant risk that competition for HMMWV will not materialize. This risk is compounded by the fact that the POM only supports the effort required to modernize the existing HMMWV and does not include enough RDT&E dollars to execute the desired competitive R&D effort among four contractors. In the event that AM General is the only viable contractor we will enter into a teaming arrangement to maximize competition at the component level to control costs. We will encourage performance-based specifications starting at the component level in the SI&T phase. Other program risks in this phase and also in the production phase are the continued availability of commercial components that fulfill the system requirements such as the engine. Simulation will be encouraged in component level selection to minimize test-fix-test iterations. Simulation efforts will be an integral part of the SI&T phase and will influence the evaluation and selection process for the production award. Exit criteria for this phase would be the milestone approval for production where the capability to meet the KPPs of the ORD at an affordable cost is verified.

4. Production, Fielding/Deployment and Operational Support

Production, Fielding/Deployment and Operational Support (PF/DOS) will commence with exit from the SI&T phase and contingent upon availability of FY02 funding.

HMMWV production will ramp up to a rate sufficient to modernize 100% of Force Packages 1 and 2 units over a 21-year period. HMMWV production, combined with the Recapitalization production quantities will improve the entire fleet over a 21-year time span and extend the expected life of the system to a minimum of 21 years. Unfortunately, some

HMMWVs may be in the field up to 36 years before they are replaced or recapitalized. Therefore, PM-LTV plans to begin a fleet management program that will include a continuous evaluation approach. Refer to the Recapitalization section for more discussion.

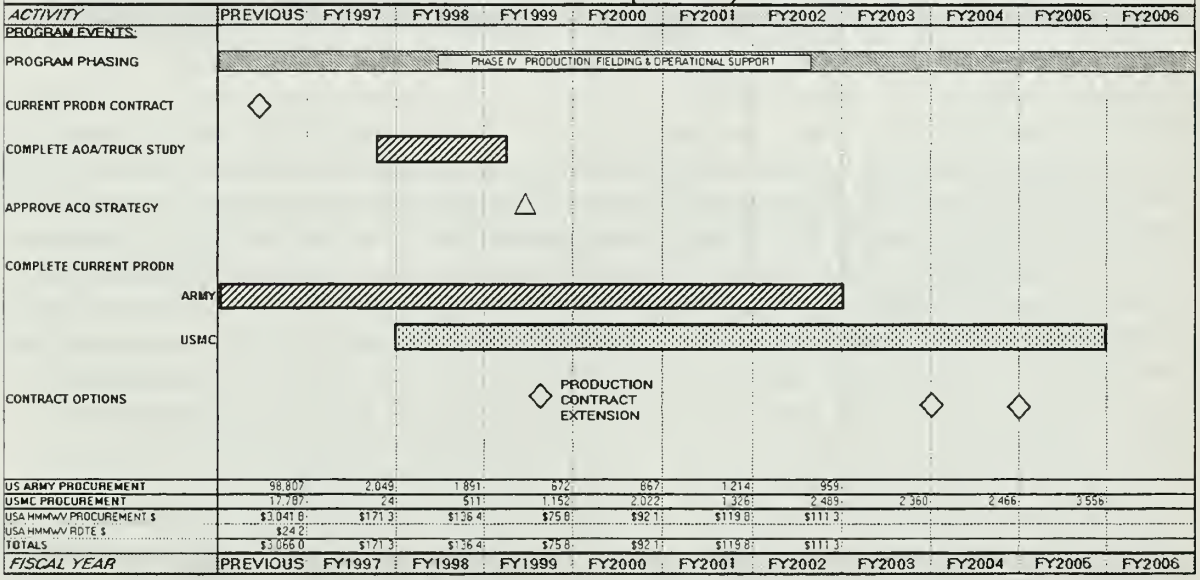
Operational Support costs will be minimized by encouraging the use of performance-based specifications. The production product will be proven in limited performance and durability testing, supplemented by simulation testing. Exit criteria include demonstration of achievement of KPPs and material release of the production vehicles to the field.

5. Future Plans

It is intended that this process be continued and updated in approximately seven year cycles and the ORD requirements updated to keep pace with military needs. This strategy allows for the potential need for a clean sheet approach to obtain the required "leap ahead" technologies and integration that AAN may require. As the AAN requirements and technology evolve, the need for a new system emerges, it could begin during any of the seven year iterations of the Spiral Modernization cycle.

D. Maintain Production

HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV) MAINTAIN PRODUCTION SCHEDULE



	PREVIOUS	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006
US ARMY PROCUREMENT	98,807	2,049	1,891	872	867	1,214	959				
USMC PROCUREMENT	17,787	24	$11	1,152	2,022	1,326	2,489	2,360	2,466	3,556	
USA HMMWV PROCUREMENT $	$3,041.8	$171.3	$136.4	$75.6	$92.1	$119.8	$111.3				
USA HMMWV RDTE $	$24.2										
TOTALS	$3,066.0	$171.3	$136.4	$75.6	$92.1	$119.8	$111.3				
FISCAL YEAR	PREVIOUS	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006

Efforts to sustain the fleet and the production base until the modernization program goes into effect will involve the sole source extension of the current production contract. Maintaining a warm production base is critical to:

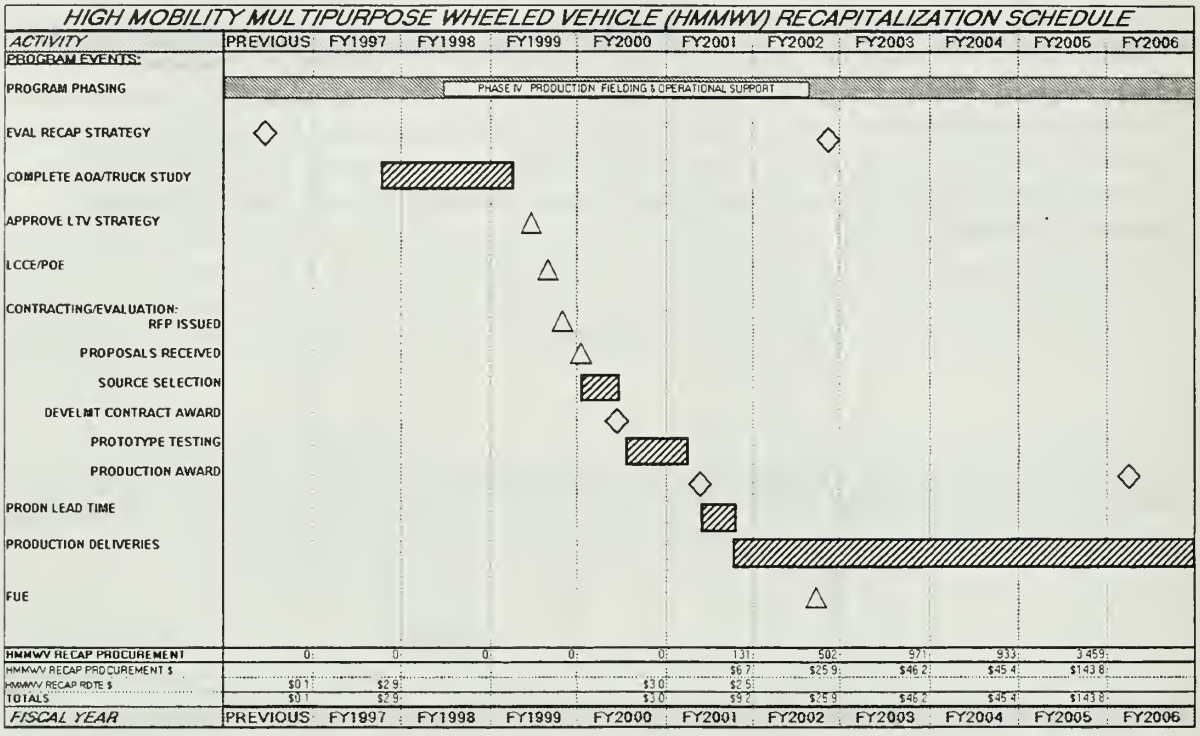
- Provide a safety net and contingency plan if the modernized HMMWV production contract should encounter delays.
- Allow the Army to continue to fill AAO shortages while planning for the future.
- Meet critical interchange to high priority systems.
- Provide a means to accomplish tech inserts.

- Provide vehicles to other services.
- Fill FMS orders.

O&S cost reduction efforts will be continued through this contract. These include corrosion prevention enhancements and high cost driver improvement changes such as the Electric Start System (ESS) to reduce glow plug, protective control box, starter and flywheel consumption. There are no milestone decisions involved with this part of the acquisition. Assuming that the Modernized HMMWV production effort is progressing on schedule, Army funding for new HMMWV production, other than interchange customers, will be directed at the Modernized HMMWV production contract. Production will continue under this contract to support Army interchange customers, other services (i.e., USMC) and FMS requirements, potentially through FY05.

E. Recapitalization

The objective of the Recapitalization program is to extend the life of the over-age HMMWVs by 21 years while enhancing performance and minimizing O&S costs.



1. Acquisition Phases

The phases for Recapitalization occur in an iterative manner: Prototype and Test (PAT) in FY00 and 10; and Production commences after IPR decisions in FY01, 06, and 11. No other phases are projected at this time, as the sole focus of this portion (pillar) of the program is the current HMMWV platform. Recapitalization and new production run concurrently. This section will detail the first iteration of Prototype and Test (PAT) and Production, which lays the foundation (baseline) for subsequent iterations.

2. Prototype and Test

RDT&E dollars are provided, commencing in FY00, to develop and validate through Developmental Testing potential technology insertion initiatives that are directly linked to O&S cost savings, as well as improvements in overall vehicle performance. Since this pillar of the program is recapitalization of a mature design with a proven manufacturing and production process, much of the risk usually associated with this phase is drastically reduced. This phase will finalize which new technology initiatives and MWOs will be applied during production of recapitalized HMMWVs. The exit criterion for this phase is approval of the Recapitalization portion of the HMMWV Acquisition Strategy, approval to commence production, and approval of the Updated Acquisition Program Baseline as it applies to Recapitalization. Length of this

initial phase is approximately 18 months. Critical during this phase is the development of induction criteria that allow flexibility while addressing age, condition (corrosion), mileage, EUL/Military Useful Life considerations, Maintenance Expenditure Limits (MEL), excessive O&S costs, and the ability to only repair as necessary proven, reliable components.

3. Recapitalization Production

Procurement dollars commence in FY01 to support this phase. The focus is on producing a recapitalized HMMWV capable of an additional 21 years service at an acceptable level of O&S cost. As each production phase runs for a projected length of five years, unanticipated modifications or upgrades may occur. However, every attempt will be made to minimize this during the efforts of the preceding phase. After five years, a subsequent production award will be made, continuing this phase to FY10. No changes from support provided to the existing fleet is planned; however, potential for transitioning more functions to a Focused Sustainment approach does exist, especially for cost reducing/performance enhancing applique initiatives peculiar to the recapitalized HMMWV. Exit Criteria for this phase are not yet developed. Concurrently with this phase of the program will be the requirement for close coordination with new production, focusing on gaining the maximum efficiency and cost savings from linking these two pillars of the program whenever possible and appropriate. During the latter portion of this phase, the Exit Criteria for the follow-on iteration of PAT will be developed. Configuration baseline and system threat assessment will be updated as necessary in conjunction with the requirement to do so for new production vehicles. Potential actions to dispose of washout vehicles in a manner that provides additional funding to the HMMWV Program will be examined. Unserviceable components will be sold as scrap and proceeds used in the Recapitalization effort. Additionally, flexibility during this phase is critical to adjusting the model mix of vehicles to meet current requirements.

Criteria will be established for the vehicle users to screen their vehicles during routine maintenance and identify candidates for induction into the recapitalization program. In addition, selected vehicles of various years of manufacture and recapitalization will be selected for comparison testing. The TACOM Fleet Planning Office will also provide PM-LTV with annual assessments and projections of vehicle condition. The PM-LTV Integrated Data Environment (IDE) and Interactive Electronic Technical Manuals (IETM) interface will be used to assist in collecting automated information to aid in decision-making.

As a result of this fleet condition and readiness monitoring, the specific model mix, quantities, and related budget information will be adjusted in the POM as necessary. The objective is to reduce the peaks and valleys of funding required to ensure adequate readiness, establish a lower steady state funding stream that can be maintained over time, maintain priority on Force Packages 1 & 2 requirements, and maintain economic production rates for both Modernized HMMWV and Recapitalization contracts. This will allow a continuous infusion of technology into a small quantity of vehicles for our most critical warfighting capability and ensure readiness of our overall force is maintained at an acceptable level. The strategy for fielding and support is outlined in Section VII, Support Concept.

V. Program Management

A. General Philosophy and Approach

This Acquisition Strategy centers on the PM's responsibility for developing a Life Cycle Management (LCM) approach to Systems Acquisition. As such, this strategy, and its implementation, will require a focus on light tactical vehicle fleet management.

The AOA forms the basis of this strategy in that it provides an objective assessment of the six alternatives identified for evaluation by DCSOPS. It concludes that no single HMMWV variant or other system alternative can meet all of the current or near term mission requirements. Finally, it provides the detailed life cycle cost data for each alternative on which to construct a composite alternative that yields the best balance of cost, schedule, performance, risk, and executability.

The challenge to PM-LTV is to implement this multifaceted strategy in a manner that achieves an economic balance between new vehicle production, system technological advancement, and recapitalization. This will be achieved by developing contracts which are: a) scaleable in scope and/or quantity; b) controllable within available funding levels and cost objectives; and c) streamlined to allow execution with a minimum of staff and lead time.

Beginning with the approval of the HMMWV JMENS, the program has been classified and successfully managed as an Acquisition Category (ACAT) III program. The program scope described within this strategy does not deviate in any significant manner other than to expand the focus to more effectively address the PM's responsibility for Life Cycle Management. A decision is required by the Defense Acquisition Executive (DAE) on the future ACAT designation of this program.

B. Responsibilities

The government is responsible for:

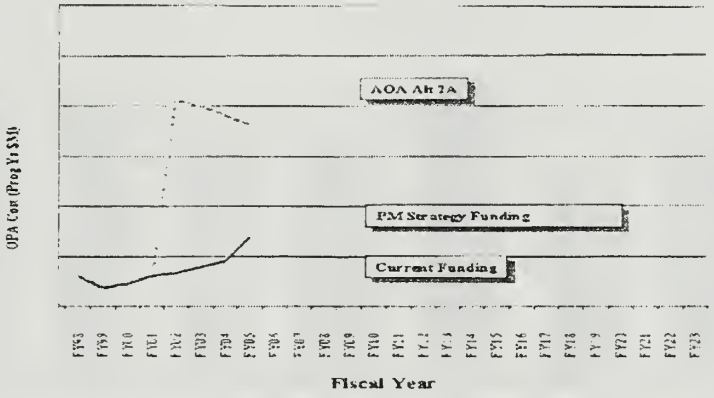
- Updating the ORD to reflect changes in current and emerging requirements through the establishment of a Cost/Performance IPT using the CAIV process. Define requirements in terms of Threshold and Objectives which support technological growth within the fleet consistent with budgetary constraints.
- Retaining configuration management control and approval authority.
- Developing criteria for inducting fielded HMMWVs into the Recapitalization program; coordinate the timely movement of fielded assets in support of contract schedules.
- Management of the HMMWV recapitalization effort will be provided by the Office of the Project Manager, Light Tactical Vehicles. The project management effort includes engineering support, logistics and maintenance support planning, reliability predictions and assessments, configuration management, quality assurance, procurement and production planning, and cost and schedule management. The PMO receives support from TACOM and other major subordinate commands as needed to accomplish mission objectives.

The Contractor(s) is/are responsible for:

- Establishing and using an Integrated Business Environment/Integrated Data Environments (IBE/IDE) which promote the streamlined business practices needed to minimize program costs and lead times.
- Maintaining Configuration Management of the HMMWV Technical Data Package to reflect technological advancements inserted in the fleet.
- Assisting in the development of criteria for selecting HMMWVs for induction into the recapitalization program.
- Committing to a Government/Industry partnering agreement and fully participate on IPTs.
- Performing system integration of technology insertions focused on achieving system performance requirements and lowering the total cost of ownership for their customer.

C. Resources

1. Funding



Funding Comparisons (Program Year $M)

	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10
Current Prog	126.2	75.8	92.1	126.5	137.3	157.4	180.4	279.6					
Alt 2A	131.9	72.7	99.2	125.9	831.8	802.3	766.6	728.4					
PM Strategy	126.2	75.8	92.1	126.5	137.2	157.4	180.4	279.6					
RDTE-Modernization			4.6	7.5	1.0								
RDTE-RECAP			3.0	2.5									
	FY11	FY12	FY13	FY					FY19	FY20	FY21	FY22	FY23
Current Prog													
Alt 2A													
PM Strategy													
RDTE-Modernization													
RDTE-RECAP													

Data beyond current POM years intentionally left blank

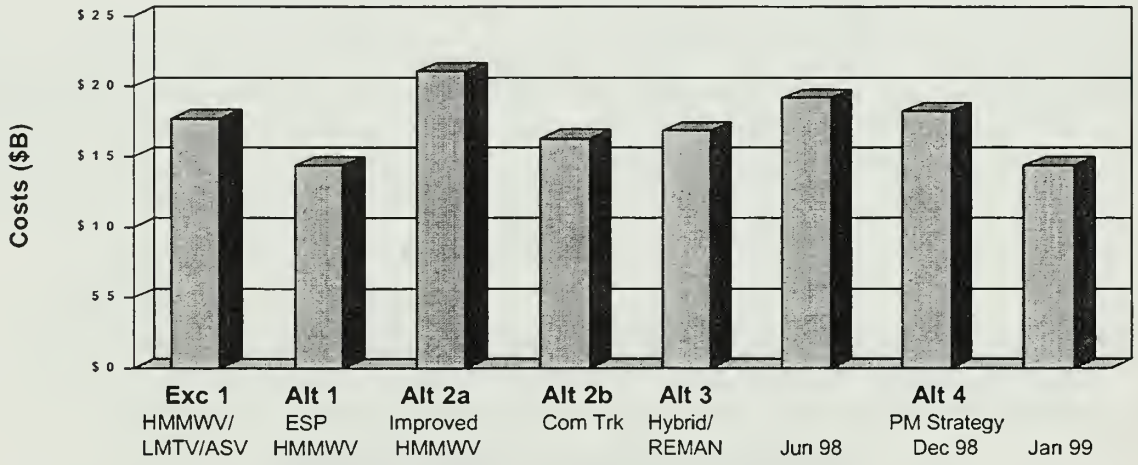
The graph above depicts:

a. The current HMMWV program funding, defined as the POM (through FY05).

b. The Other Procurement-Army (OPA) funding level that would be required to execute Alternative 2a (Improved HMMWV) of the AOA through FY05.

c. The OPA and RDT&E funding levels required to execute this acquisition strategy through FY05. The RDT&E funding levels displayed for the period FY98-05 are, in fact, the current program funding levels, and are minimally sufficient to execute this strategy during that period. PM-LTV has conducted analysis of historical cost data, analigous cost data from similar programs, and projections based on our known requirements. PM-LTV concluded that current RDT&E funding levels are only sufficient to fund a single contractor effort. Having only one contractor for the development phase locks the program into a sole-source award for production. Lack of competition for production will potentially increase cost. The OPA funding levels displayed for the period FY98-05 are also current program funding levels, and are minimally sufficient to execute this strategy. See Section VI, Risk Assessment for further details.

20-year LCC, Program Alternatives
(Procure shortfall, upgrade, replace, & sustain)

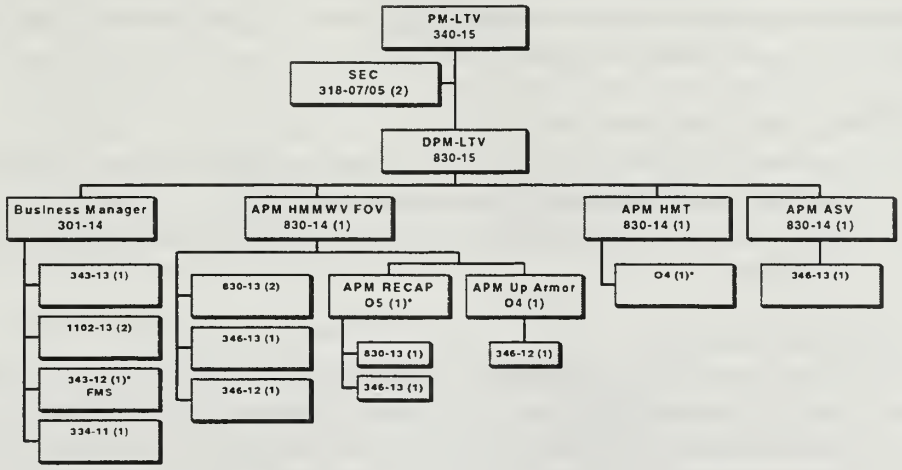


The chart above depicts the total program cost (less Military Personnel-Army (MPA) dollars) required to execute the alternatives considered in the AOA. Note that the AOA concluded that only Alternative 2A (Improved HMMWV), Alternative 4 – June 1998 PM Strategy (Improved HMMWV with Hybrid Remanufacturing), Alternative 4 – December 1998 PM Strategy (Improved HMMWV with Recapitalization), and Alternative 4 – January 1999 (Improved HMMWV with Recapitalization at 60% cost of Improved HMMWV, which is reflected in this strategy), have the potential of meeting the HMMWV ORD performance requirements.

2. Staffing

a. Government

Government staffing will be maintained at the minimum level consistent with effective program oversight and control of program cost, schedule and performance. Current PM-LTV staffing is presented below. It is expected that as this and other programs under the purview of the PM-LTV expand in scope and complexity, some additional core resources will be required.



b. Contractor support

As an alternative to hiring DA civilians to augment the PMO staff, maximum use will be made of technical support contracts.

D. Internal Controls

Effective controls will be established and maintained using DoD 5000.2-R, Part 3.3.5.1 as a guide.

E. Tailoring and Streamlining

1. Requests for Relief/Exception from Requirements

- Authority will be requested to dispose of non-economically repairable assets through the recapitalization contract for salvage value as an offset to the contract costs.
- Request authority for "like kind" exchange to sell serviceable assets and return funds to the program to finance new assets.

2. Other Tailoring or Streamlining Plans

- Maximum use will be made of requirements contracts for new vehicle production, recapitalization, and Technical Insertion materials as a means of maintaining flexibility in the program.
- Maximum use of acquisition streamlining initiatives and other innovative approaches within acceptable risk levels.

- Incentives will be employed as a means of encouraging the contractor to seek continuous process improvements that will result in reductions to the total cost of ownership. Metrics will be established and reported quarterly to track progress.

F. Approach to Managing Program Costs and Performance

1. Earned Value

Earned Value Management techniques will be utilized during the Recapitalization and Modernization developmental efforts to minimize program costs, maximize the quality of the development efforts, and protect program schedules.

2. Establishing Cost Objectives
   - A revised HMMWV Life Cycle Cost Program Office Estimate (POE) will be establish leveraging the AOA cost analysis data.
   - CAIV processes will be utilized to establish cost thresholds for critical program elements.

3. Managing Tradeoffs
   - A Cost/Performance IPT will be established with total participation of the PMO and the user community in revising the HMMWV ORD by conducting cost/benefit analyses and applying CAIV principle as a means of establishing realistic thresholds and objectives within the requirements document.
   - Emerging technologies, identified through independent programs such as COMBATT or R&D initiatives supported within this strategy, will be evaluated for their cost and potential for eliminating O&S cost drivers or achieving performance objectives as defined in the ORD.

4. Government Role in Managing/Approving Tradeoffs
   - Design reviews will be required as a part of the System Integration and Test of the Modernized HMMWV.
   - Metrics and thresholds will be established.
   - All threshold breaches will require PM approval prior to IPT implementation.
   - All tradeoff analysis will include User representatives input.

VI. Risk Assessment

Risk is an undesirable situation or circumstance which has both a probability of occurring and a potential consequence to program success; risks are normally associated with uncertainties. Risk management is an organized, systematic decision-making process that efficiently identifies risks, assessor analyzes risks, and effectively reduces or eliminates risks to achieving program goals.

Risk management applies to all organizational levels and includes decision makers, program managers, and functional area experts. Risk management is necessary to deliver quality materiel to the customer in a timely manner at a reasonable price. Risk management is an integral part of program and functional area management throughout the program life cycle and should be thought of as an evolutionary and continuous process. Government and industry both require program planning to manage risk in decision-making and the application of resources. The program planning and risk management processes are tailored to support the milestone decision review of the system being acquired.

A. PM-LTV Risk Management Process

PM-LTV will maintain a risk management program through the entire life cycle of the HMMWV to identify and mitigate performance, cost, and schedule risks. The risk management program shall identify and track risk drivers, define risk abatement plans, and provide for continuous risk assessment throughout each acquisition phase to determine how risks have changed. Risk reduction measures will be included in cost-performance trade-offs, where applicable. The risk management program will plan for back-ups in risk areas and identify design requirements where performance increase is small relative to cost, schedule, and performance risk. The acquisition strategy will include identification of the risk areas of the HMMWV program and a discussion of how the PM intends to manage those risks. The figure below describes the approach PM-LTV will follow in risk management. Following it are descriptions of each phase:

PM-LTV Risk Management Process

Risk Identification – What Can Go Wrong?

- Proposed changes
  - Staffing
  - Process
  - Design
  - Suppliers
- Transition to production checklists
- Test failures
- Failure to meet objectives
- Simulations
- Negative trends
- Issues list
- …and more

Risk Analysis – How Big is the Risk?

- Likelihood
- Possible consequences
- Categories
  - Cost
  - Schedule
  - Technical
- Identify the risk level from the 5X5 risk grid below

Risk Planning – How Can You Reduce the Risk?

- *Avoid* by eliminating the risk cause and/or consequence
- *Control* the cause or consequence
- *Transfer* the risk
- *Assume* the risk level and continue on current plan
- … and more

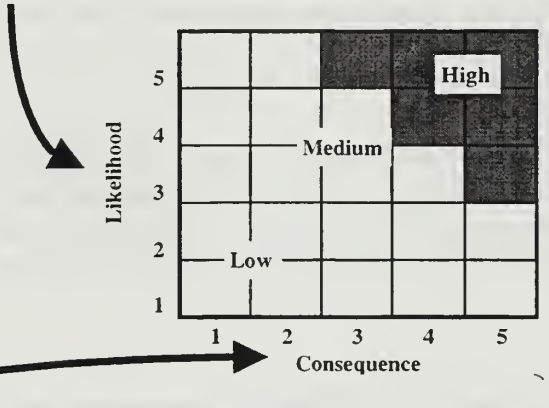
Risk Tracking – How Are Things Going?

- Communicate risks to all affected parties
- Monitor risk plans
- Regular status updates
  - Team
  - Parent Team
  - Program management

B. Program Risk Analysis Methodology

Program risk analysis assesses the degree of risk associated with a program event or situation. Early identification of program risk, along with an objective analysis of the likelihood of the occurrence and magnitude of the impact will ensure that the LTV project office is prepared to respond in the best interests of the Army as risks develop. The tables below describes the Program Risk Analysis decision matrix to characterize program risks:

What is the Likelihood the Risk Will Happen?		
Level		**Your Approach and Processes:**
1	Not Likely	Will effectively avoid or mitigate this risk based on standard practices.
2	Low Likelihood	Have usually mitigated this type of risk with minimal oversight in similar cases.
3	Likely	May mitigate this risk, but workarounds will be required.
4	Highly Likely	Cannot mitigate this risk, but a different approach might.
5	Near Certainty	Cannot mitigate this type of risk; no known processes or workarounds are available.



Given the risk is realized, what would be the magnitude of the impact?			
Level	**Technical**	**Schedule**	**Cost**
1	Minimal or no impact	Minimal or no impact	Minimal or no impact
2	Minor perf. Shortfall, same approach retained	Additional activities required; able to meet key dates	Budget increase or unit production cost increase <1%
3	Mod. perf. Shortfall, but workarounds available	Minor schedule slip; will miss need date	Budget increase or unit production cost increase <5%
4	Unacceptable, but workarounds available	Program critical path affected	Budget increase or unit production cost increase <10%
5	Unacceptable; no alternatives exist	Cannot achieve key program milestone	Budget increase or unit production cost increase >10%

C. PM-LTV Risk Summary and Mitigating Actions

1. Funding

a. RDT&E Funding

To successfully optimize this strategy, additional funding may be required. If additional funding is not provided, the contract strategy includes plans to reduce the number of developmental contracts awarded consistent with the funding available. If the program is unable to create competition in the current sole-source environment, the scope of industry input will be seriously reduced in developing cost effective technical solutions and will potentially increase the cost. The Army is committed to supporting the strategy and finding additional funds within the Army.

In order to mitigate the risk of increased cost given current RDT&E funding levels, PM-LTV will increase the partnering efforts with AM General. Through the partnering approach, innovative thinking, use of IPTs, and other key enablers, we will minimize the costs of the sole source situation. Also, flexibility is built into this strategy, such that, if competition is not possible in the first cycle, there are opportunities built into the Spiral Modernization strategy to re-introduce competition.

b. Procurement Funding

If this strategy is executed at the Extended Program Plan (EPP) levels, a) 78% of the fleet will be overage in FY10, b) it will take over 50 years to replace the fleet, c) O&S costs will rise, and d) Modernization and Recapitalization production will run at less than economic rates, resulting in increased costs. Therefore, adjustments to the EPP will be included in the next POM cycle submission.

2. Competition

Based on the lack of competition the HMMWV has received in the past, with projected future quantities less than what the Army procured historically, there is a risk of not receiving competition of future requirements, especially with other contractors competing against the incumbent vehicle manufacturer. A sole source contract with the incumbent HMMWV manufacturer may increase the risk of gaining a reasonable vehicle price. Competition in itself helps keep a contractors proposed price in line with other offerors. A sole source contractor may not be so constrained.

3. Seven Year Contract

Utilizing a seven-year contract (5-year multi-year plus two additional option years of production) leaves the funding in the Army budget for the option years vulnerable for reductions. The funding for the multi-year program years is protected by the additional costs the Army would incur in paying cancellation fees for termination.

4. Recapitalization Program Control

To manage risk under the recapitalization program, periodic technical/ management

reviews will be held with the contractor and other supporting activities to ensure that program progress is being accomplished in an efficient and effective manner. As a minimum, Production Progress Reports will be required. These reports will be used in coordination with the cognizant Contract Administration Office to monitor contractor effort and progress under the contract. Performance and cost data will be requested to the extent necessary.

5. Availability of Commercial Components

There is risk in the continued availability of commercial components such as the engine. In order to manage program risk in this area, we will work closely with the component suppliers to accurately forecast and procure sufficient engine quantities to support future vehicle production until the end of the current contract. Environmental waivers for the engine must be obtained but informal contact with the Environmental Protection Agency (EPA) indicates that a relatively short term waiver could be obtained.

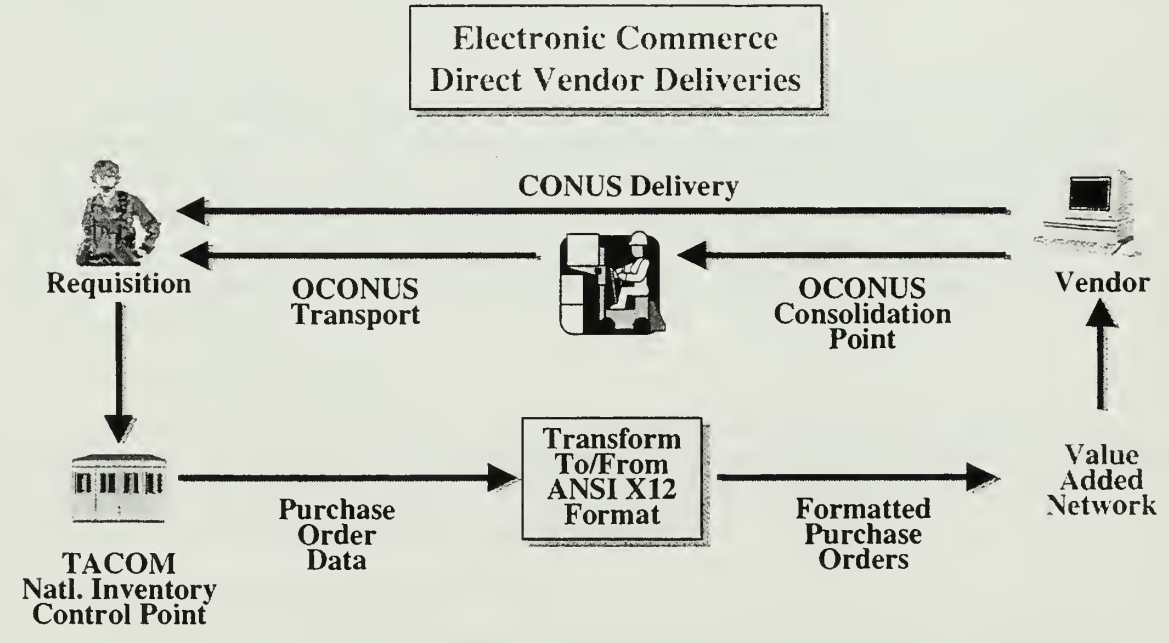
6. Modernized HMMWV Production Lead Time

There is risk associated with the length of time it will take to start producing Modernized HMMWVs after the production award, particularly if a new contractor is selected. Based on historical data, the average time from production contact award to delivery for trucks, for contractors who have not produced the product, is four years. This risk will be mitigated by establishing options on the existing contract to allow continuation of production until the Modernized HMMWV is delivered.

VII. Support Concept

All HMMWV program alternatives will be supported using the current logistics and maintenance structure established for Army wheeled vehicles using the existing four level Army Maintenance System with repair parts available through the established supply system. Interim Contractor Logistics Support (ICLS) is envisioned in order to support Authorized Support List (ASL) requirements until appropriate standard supply levels are built. This is estimated to occur no later than the end of the first multi-year production contract. Contractor Depot Level Support (CDLS) is not envisioned. Details for transition from ICLS to organic support will be provided as part of the Logistic Support Plans.

The HMMWV program will also explore alternative strategies, such as, use of Electronic Commerce (EC)/Direct Vendor delivery (DVD) for new and unique items that are introduced by the HMMWV FOV. This approach will be subject to cost and benefit analysis to document whether O&S savings are possible, as well as, that the retail/wholesale, stockage-based logistic system could be augmented by a more responsive direct distribution system that meets the user's needs, including wartime mission and deployment. This analysis will be ongoing with preliminary results expected in mid 1999. Included with the EC/DVD concept will be use of a return for credit or return for repair to the DVD contractor as an option to the user. This is intended to improve flexibility in managing scarce maintenance resources as well as offering possible means of improving turn around time to repair by contractually requiring specified delivery or turn around days based on priority. In any case, the intent to use EC/DVD logistic support would also be based upon making the EC/DVD logistic support approach seamless from standard system procedures to the user.



The HMMWV logistics approach will also maximize the use of digital tools to aid in the maintaining of the system. IETMs will be fielded with the end item. The IETM will include a Computer Based Inter-active Training System (CBITS) section enabling the maintainer to familiarize or refresh themselves with theory and operation of components of the system. The IETM will also include an interface with the Unit Level Logistics System (ULLS) and/or the global Combat Support System (ARMY) for automated parts requisitioning. The IETM will interface through the HMMWV databus to vehicle sensors to isolate faults and guide the maintainer through the diagnostic process. The IETM will link troubleshooting steps, repair tasks, and repair parts information, including follow-up troubleshooting to ensure that all faults are addressed and complete repair has been accomplished. The goal of the IETM is to shorten down time, reduce maintenance man-hours, reduce "No Evidence of Failure (NEOF) rates, improve readiness and expedite parts ordering while reducing errors in the requisitioning process. The use of available technology to improve diagnostics will reduce support costs for the weapon system. This, coupled with identifying O&S cost drivers, and examining diagnostics systems that will improve capability through increased accuracy, reduced diagnostics time, eliminating or reducing parts stockage, is part of the overall strategy to reduce O&S costs.

As an inherent part of our business we will utilize a continuous process that will determine the O&S cost drivers, provide for a cognitive technical review and recommend changes or alternatives that will lower operating and support costs throughout the life cycle of the equipment. These changes can be accomplished through the introduction of new materials, technology design or fabrication processes. Identification of cost drivers that impact O&S cost is through the data bases that support wholesale and retail maintenance management such as the Operating and Support Management Information System (OSMIS) and Work Order Logistics File (WOLF).

VIII. Business and Contracting Strategy

A. Modernize and Maintain Production

The High Mobility Multi-purpose Wheeled Vehicle (HMMWV) family of vehicles has been solely produced by AM General Corporation, South Bend, Indiana, since 1985. The HMMWV Up-Armored vehicle model is produced by two manufacturer's. The vehicle chassis is manufactured by AM General Corporation, which is then provided as Government Furnished Material to O'Gara-Hess & Eisenhardt Armoring Company (OHE), Fairfield, Ohio, who then armors the chassis and delivers the end product. OHE has been sole producer of the Up-Armored vehicle.

1. Procurement Competition and Contracting Strategy

The HMMWV was first procured through the use of a performance specification. Three contractors each designed and delivered eleven prototype vehicles for Government test and evaluation. As a result of a formal source selection process, AM General was selected as the winner of the production effort, and contract award was made in March 1983 to acquire 49,808 vehicles with 100% option on a five-year multi-year basis.

The first rebuy acquisition was solicited, using a level III Technical Data Package (TDP), on a limited competition basis under a Two-Step Invitation for Bids (IFB). AM General submitted the sole technical bid under Step One of the IFB and, as a result, the acquisition was then continued with a Request for Proposal (RFP) issued sole source to AM General. In August 1989, a five-year multi-year contract was awarded to AM General Corporation to acquire 33,331 vehicles with 100% option. A two-year STS level of effort was included in this contract award. The U.S. Marine Corps and the Army had a joint program agreement for this rebuy contract, in which the U.S. Marine Corps participated in the program year funding/quantities of the fourth and fifth program years.

The second rebuy acquisition was executed in two contractual phases. A sole source letter contract was awarded to AM General in December 1994 to acquire 1,201 HMMWVs for the Army. This contract served as a production bridge while a HMMWV requirements contract was being negotiated sole source with AM General. In December 1995, a five-year requirements contract was awarded, based on a level III TDP. The requirements contract has an estimated maximum quantity of 13,800 vehicles. To date, a total of 9,481 vehicles have been acquired. The contract, valid through October 2000, will be extended through FY03 to continue to fill AAO requirements for Army interchange customers, USMC, U.S. Air Force, and FMS.

The PM plans on issuing a formal market survey with an attached draft system performance specification in Apr 99, soliciting for interest, comments, and program recommendations. Up to four two year Cost Plus Incentive Fee (CPIF) contracts will be awarded in FY00 for systems integration and testing of vehicles against the ORD requirements. This strategy will potentially inspire other truck manufacturers to become competitive prior to the FY02 down select and production award. The modernized HMMWV vehicle program will be solicited using a system performance specification with the HMMWV TDP included as a

reference only. The modernized HMMWV production contract will be awarded in FY02. Based on the historical lack of competition received for the previously solicited HMMWV procurements, there exists a moderate risk of not getting any offerors other than AM General for the HMMWV. However, the COMBATT dual use demonstration program includes three commercial vehicle contractors, each of whom may have a continued interest in pursuing a competitive production contract with the Army

The contracting strategy for the procurement of HMMWVs is broken down into a near term approach and an out year approach, as outlined below. The attached milestone chart lays out the procurement major event time lines for both of the contracting approaches.

The PM intends to continue the procurement of the currently configured HMMWVs from AM General Corporation, through FY03, on a sole source basis under the current requirements contract. The additional effort under this contract will require sole source approval to add in an additional two years of production, possible increase in the maximum estimated quantity, and probable unit price re-negotiations. Vehicles will be procured to a technical data package with negotiated firm fixed prices. It is planned that the vehicles acquired under this contract, produced at the contractually negotiated production rate of 10 vehicles per day (approximately 2,350 per year) will run production through FY03, satisfying Army requirements while acting as a bridge to the next production contract for modernized HMMWVs.

The PM plans acquiring the modernized HMMWV vehicles, starting in FY00, using a two-phased procurement approach. The first phase will be a competitive development contract, funded with RDT&E funding, for system integration and testing of technical insertions and vehicle modernization. The development phase will be solicited using a system performance specification based on the new ORD. A cost-plus-incentive-fee type of contract is planned for this effort. Depending upon funding availability, contract awards, based on a paper down-select, will be made to up to four contractors who will deliver up to a maximum of six vehicle models for testing run-off. The contractors will also be required to deliver a performance-based specification with supporting documentation, which will be utilized in the phase two production contract. The PM anticipates several domestic as well as foreign truck manufacturers will compete for these developmental contracts. Best value, source selection procedures will be utilized in the selection of the development contract winners.

The second phase of the procurement approach is production contract award. Best value, source selection evaluation procedures will be utilized to down select from the four developmental contracts to a single production contract winner. The type of contract planned for production is a firm fixed price, five-year multi-year contract with an two additional production option years, plus 100% option against the total multi-year quantity. Quantities estimated by year are found on the HMMWV Fleet Program Outline chart in Section IV.A., Program Status. The PM plans to include in the production contract provisions for only newly identified, initial/spare parts Contractor Logistics Support (CLS), with an incentive clause for timely delivery and maintaining a high readiness rate. The contractor will be required to provide, as a deliverable, a performance based specification with supporting documentation which enhances the vehicle drawing package, that is suitable for competitive procurement. These will be used to competitively acquire vehicle components as well as re-solicit the vehicle procurement.

The PM plans to procure HMMWVs in seven year cycles, through FY23, repeating the two-phased competitive contracting approach discussed above for each cycle. The developmental phases will leverage the latest advances in technology found in both the government and private sectors. Each procurement will be acquired using performance based specifications with supporting documentation that enhances the HMMWV drawing package.

2. Joint Requirements

The U.S. Marine Corps has been and continues to be partners with the U.S. Army in the procurement of HMMWVs. The U.S. Marine Corps plans to acquire new HMMWV vehicles, to replace their fleet, in concert with the Army's acquisition strategy. The services will enter a joint mission requirement, with a signed Memorandum of Agreement, which will tie the U.S. Marine Corps funding in with Army funding. The Army and the U.S. Marine Corps will combine requirements to mutually determine and fund program quantities for both the currently configured HMMWV under the requirements contract as well as the multi-year competitive procurement. The U.S. Marine Corps funding started in FY98 and continues out to approximately 2005, with a total overall requirement of about 18,000 HMMWVs.

Other DOD services, Government agencies, and Foreign Military Sales have provided funding to the Army for procurement of their HMMWV requirements. The following quantities of HMMWVs have been acquired for various customers from the start of the HMMWV program back in 1983 to date:

Other Army:	2,200
U.S. Marine Corps	18,582
U.S. Navy	585
U.S. Air Force	3,790
Foreign Military Sales	9,769

The PM anticipates receiving the approximately the same number of customer HMMWV requirements identified above over the next decade, due to the age of the fleet.

3. Acquisition Streamlining

The Army plans on utilizing as many streamlining initiatives as necessary to meet overall program requirements. The planned market survey will be electronically issued, as well as the competitive R&D solicitation. Alpha contracting will be used to negotiate both the current HMMWV program additional effort as well as the future HMMWV production contract. The PM anticipates executing a formal partnering agreement with the winner of the future production contract. Specifications and standards will be used minimally in all solicitations, with waivers sought when required. Offerors will be encouraged to utilize, to the maximum extent possible, Single Process Initiatives (SPI) in the manufacturing of its vehicle. The PM has already formed an Integrated Process/Product Team (IPPT) to collectively plan and execute the program strategies, and will continue to use the IPPT throughout the life of the program. CAIV will be applied by the IPPT throughout the program. A Cost Performance IPT has also been established to perform trade analysis on all ORD KPPs based on risk, Life Cycle Cost and performance considerations.

The PM-LTV IBE, enabled by the IDE, will be used to encourage creativity and reduce overall costs in meeting the user requirements. Refer to Section IX, Other Important Considerations, for additional information.

B. Recapitalize

1. Industry Involvement in the Program to Date

An initial market survey was issued 25 November 1996 that requested industry comment to an effort that would combine remanufacturing as well as new production vehicles that would replace the HMMWV. In response to this survey, which was mailed to over 200 companies and synopsized in the Commerce Business Daily (CBD), twenty written responses were received. Of these twenty, eight were potential prime contractors and twelve potential component suppliers. Because of a significant change in program definition (no longer pursuing new production vehicles, but including STS and ICLS, a second market survey was issued 11 September 1997, with over 170 hard copies mailed, and notice published in the CBD. In addition, the survey and draft system specification was published on the PM-LTV web site at www.pmltv.com to generate maximum interest. As a result of this second survey, a total of seventeen responses were received. Of the seventeen, ten stated they were interested and responded to the survey questions. The program has now evolved from Remanufacturing to Recapitalization and will no longer include STS. An Industry Day is planned which will afford potential contractors the opportunity to provide additional input prior to release of the Recapitalization solicitation in FY99. In FY00, three eighteen-month development contracts will be competitively awarded to solicit recapitalization concepts from industry and to produce prototypes against the HMMWV TDP with performance enhancements such as 21 year corrosion protection.

2. Competition.

Results of the earlier market surveys indicate that there are numerous sources (including foreign and domestic manufacturers, depots and the National Guard) interested in this recapitalization effort. The solicitation for the development contract will be issued on a full and open competition basis with no restrictions. One follow-on production contract, with limited competition, will be awarded based upon the results of test and evaluation of the vehicle prototypes and production proposal evaluation.

3. Contracting Strategy

a. Major Contracts Planned.

Contracts will be awarded in two phases. The first phase will be a development contract for Prototype and Test (PAT) utilizing RDT&E funds. The second phase will be the production contract. In the development phase, contractor-proposed Scopes Of Work (SOW) will be evaluated and, as a result of the best value source selection process, three contracts will be awarded. During development, each of the three contractors will build six prototypes, which will be subjected to contractor and Government testing in order to thoroughly evaluate each contractor's proposed design. Upon completion of PAT, the second phase for production will commence. The results of PAT, along with contractor production proposals, will be evaluated during the best value source selection process. As a result, one HMMWV Recapitalization

production contract will be awarded. Requirements for follow-on recapitalization contracts will be evaluated individually and determinations made based on targeted quantities and conditions existing at the time. Estimated quantities, by year, are shown on the HMMWV Fleet Program Outline chart shown in Section IV.A., Program Status.

b. Contract Structure.

1) Basic Contract.

It is planned to solicit proposals using a Statement of Objectives (SOO) in lieu of a SOW. The SOO specifies the Government's top level, overall objectives of the effort and will include the HMMWV TDP for reference. In response, the contractor prepares the SOW containing the details and submits it along with his proposal for evaluation. Use of a SOO provides offerors maximum flexibility in developing cost-effective solutions and in proposing innovative alternatives to meet the Government's objectives. The PAT/development phase is planned as an eighteen-month effort. For the production phase, a five-year requirements contract is planned rather than a multiyear to provide flexibility in adjusting the specific quantities. The quantities to undergo recapitalization will be affected by the actual condition of the vehicles to be inducted into the program and the washout criteria to be established. The initial contract will be awarded in 2QFY00, with the production contract being awarded in FY01. Subsequent awards for follow-on contracts are planned in order to sustain continuous production. The PM plans to time the future Recapitalization contracts to follow on the heels of the modernized HMMWV contract in order to leverage the technology insertion opportunities that result from that effort.

2) Options

The production effort will include an option to procure an update to the HMMWV performance-based specification, along with supporting documentation. Also included, in both phases, will be an option for Field Service Representative (FSR) support.

c. Contract Type

The recapitalization development contract will be awarded as a CPIF-type of contract. The production effort will be awarded using FFP.

d. Incentives

The use of FFP is considered to be the most beneficial because it places maximum risk and responsibility on the contractor for all costs and his resulting profit/loss. It also provides the maximum incentive for the contractor to control his costs in this area and perform effectively and efficiently. It is also planned to include vehicle performance incentives to encourage the contractor to build a reliable and high quality product. The performance incentive will be based upon results of regularly scheduled Government-run and Government-scored comparison testing which will be conducted on randomly selected vehicles.

e. Special Contract Terms and Conditions

No special or extraordinary contract terms or conditions are being contemplated at this time.

4. Component Breakout

Breakout will not be employed in the traditional sense, in order that responsibility and risk for material delivery and conformance is retained by the contractor. However, analysis will be conducted to assess the cost benefit to the government from consolidating the procurement of selected components required under both the Modernization and Recapitalization production efforts. Where analysis demonstrates sufficient cost benefit, clauses will be exercised under the Modernization contract to procure and deliver those selected components to the Recapitalization contractor.

5. Acquisition Streamlining.

Only the minimum essential requirements will be included in the solicitation and resulting contract for recapitalization. The functional templates provided for guidance will be used by the HMMWV Recapitalization IPT members and requirements tailored for this specific action. Since the solicitation will be issued utilizing the SOO approach, requirements will be stated at the top level, with the contractor providing the details of its approach in its proposed SOW. Therefore, it is not the Government's intent to specify performance in accordance with any military specifications or standards. Electronic delivery of data items will be mandatory. After contract award, Government and contractor personnel will receive partnering training, and a partnering agreement will be jointly prepared.

IX. Other Important Considerations

A. Integrated Data Environment/Integrated Business Environment

Success in implementing this strategy is contingent on the PM's ability to communicate and coordinate, in real time, with user and industry partners. The breath and complexity of this program demands the ability to acquire and analyze a variety of data, process that data to form or update programmatic decisions, and implement actions which properly influence the execution of the program objectives. Given these realities, the PM has developed a Government Concept of Operations (GCO), and is aggressively implementing steps to establish the IDE/IBE.

B. Dual Use Technology

The application of dual use technologies is central to this strategy. From its inception, the HMMWV design has made significant use of commercial technologies as a means of reducing design, manufacturing, and ownership costs. This strategy has been structured to build on that philosophy and advance the use of commercial technologies.

Commercially available systems must be identified, evaluated, and integrated into the HMMWV design to replace those commercial items used in the current design which, owing to changes in the commercial market, will no longer be available to support the existing fleet and current production.

Commercial technologies will be identified, evaluated, and integrated into the HMMWV design where analysis indicates system performance enhancement can be achieved cost effectively or O&S costs can be reduced. Where technologies are proven to be cost effective, they will be incorporated in vehicle production programs and in the fleet through Modernization Through Spares and field mod initiatives.

The COMBATT program, which will be leveraged to support HMMWV modernization and recapitalization efforts, is by design focusing on the adaptation of current and emerging commercial truck technology to military applications.

Both the HMMWV Modernization and Recapitalization development contract requirements will be defined utilizing performance specification which will maximize the contractor flexibility to respond with solutions based on commercial designs.

C. Environmental Issues

In July 1989 the Project Manager for Light Tactical Vehicles approved the HMMWV Life Cycle Environmental Assessment. This assessed the environmental impacts of the basic HMMWV on air quality, noise, and soil; and the impact of the production facility, disposal, related hazardous materials, and other impacts on the environment. Following is a summary of the July 1989 Environmental Assessment for the HMMWV:

1. Vehicle Impact on Air Quality

The vehicle is required to comply with EPA emission standards in effect during the initial

year of manufacture of the rebuy program. During initial HMMWV production, 1984 through 1987, the 6.2 liter diesel engine conformed to EPA emission standards. In 1988, however, EPA allowable emission levels were changed to incorporate particulates, a previously unregulated exhaust component. While the engine fully met HC, CO and NO_X by several fold, engine particulate emissions exceeded the new 1988 particulate standard by 0.16 gm/Bhp-hr. Upon the request from TACOM, EPA granted a National Security Exemption (NSE) for engines produced from 1988 through 1990. During the rebuy contract which began in 1990, the engine complied with all EPA emission requirements in effect for 1990, including particulates. The HMMWV emits odors caused by diesel fuel combustion; however, the overall impact of combustion odor is minimal. Except as discussed above, the HMMWV has complied with the Clean Air Act (CAA) and the overall impact of the vehicle on air quality is rated Not Significant.

2. Vehicle Impact on Noise

The HMMWV system specification requires interior noise levels to conform to MIL-STD-1474 where steady state noise levels are required to be less than 85 dBA. Continuous exposure to noise levels in excess of 85 dBA maybe hazardous. (TB MED 501, 15 Mar 1980). During testing, the HMMWV has conformed to MIL-STD-1474 except for the passenger positions on a few models which are discussed below. The Health Hazard Assessment Report for HMMWV Group II identifies the worst case exposure to noise under the expected use scenario to be 50 minutes at 86 dBA for ambulances and 45 minutes at 89 dBA (75 mile mission) for shelter carriers. While these noise levels are above the continuous 85 dBA hearing protection threshold, they are not considered hazardous to hearing because of the limited time exposure. Since these variants are the worst case for the HMMWV, the overall impact of the vehicle on noise levels is rated Not Significant.

3. Production Facility Impact on Environment

The Contractor is bound by contract clauses identifying Federal Acquisition Regulations (48 CFR Chapters 1 & 2) which require compliance and certification to Environmental Laws. They include but are not limited to; the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 USC 1251, et seq) (1976), and the Clean Air Act, as amended (42 USC 7401, et seq.) (1979 Supp.). The Contractor's production facility is operated in compliance with Federal, State and local air, water, and solid waste regulations. The overall impact of the production facility is rated Not Significant.

4. Disposal Phase

Vehicles will be disposed of in accordance with standard property disposal procedures associated with military vehicles. Special disposal facilities will not be required. TACOM will maintain a maximum dollar value for repairs, which decreases throughout the life cycle of the vehicle. When the vehicle repair estimate exceeds the maximum value, TACOM issues a list of parts to be cannibalized and re-utilized from the vehicle. All parts are redistributed within the Department of Defense or sold for reuse or scrap by the local Defense Reutilization and Marketing Service Office. The overall impact of vehicle disposal is rated Not Significant.

5. Impacts of Related Hazardous Materials (HazMat)

HazMat are not required. The overall impact of HazMat is rated Not Significant.

6. Impacts on Soil

The HMMWV will impact soil in the same manner as other on/off road vehicles. Vehicles will use paved surfaces when available. Fluids and lubricants used in the HMMWV are basic automotive type: engine oil, differential gear lube, transmission fluid for both primary transmission and transfer transmission; silicone brake fluid, automotive antifreeze, and diesel fuel. In addition to the manufacturer's recommended commercial fuels, vehicles will be operated on fuels conforming to VV-F-800, MIL-T-5624, MIL-F-46162, and MIL-T-83133. Lubricants conforming to MIL-L-2104, MIL-L-2105, MIL-L-46167, and MIL-G-10924 shall also be used. These fluids will penetrate soil when accidents or seal/equipment failures occur. The overall impact on soil is rated Not Significant.

7. Other Environmental Impacts

There are no significant biological or cultural impacts anticipated as a result of the HMMWV program. Socioeconomic effects include payroll to support production, and various sub-contractors. The impact on public utilities from the HMMWV program will be minimal. Power requirements should not exceed earlier production levels. The overall impact on other environmental factors is rated Not Significant.

In 1994 the HMMWV project office conducted an extensive review of contractual documents to determine the extent of use of Ozone Depleting Chemicals (ODC). This review was required by Section 326 of the National Defense Authorization Act for Fiscal Year 1993. The review determined that six specifications or standards were affected by the requirement. Of those six, only the requirement to eliminate Freon as a refrigerant in the M997 4-litter ambulance air conditioning system was determined to not be economically feasible. At the time of the determination, only 39 ambulances remained on contract to be built. An economic analysis determined that it would be more cost-effective to retrofit all ambulances to use HFC-134a refrigerant rather than halt production of the remaining ambulances until engineering work was completed to introduce the new refrigerant into production.

In June 1996 the Environmental Assessment was updated with a Record of Environmental Consideration to cover production of the HMMWV A2 series and the Expanded Capacity Vehicle (ECV). These vehicles included a new 6.5 liter naturally aspirated engine and a catalytic converter to meet Environmental Protection Agency (EPA) emission standards in effect for 1995. The XM1114 Up-Armored ECV has a turbocharged 6.5 liter engine and also has an air conditioning unit that does not use an ODC.

D. Safety

The HMMWV was designed to ensure functionality, ease, and safety of operation for all functions performed by operational and maintenance personnel based on 5th percentile female through 95th percentile male soldiers. Safety factors in the designs and specifications were dictated by the following:

- MIL-STD-1180, Safety Standards for Military Ground Vehicles
- FMCSR
- FMVSS

The 1983 specification for initial HMMWV production had the following requirement:

> *"Exposed components and systems which are subject to high temperatures, high pressures, electrically actuated, or inherently hazardous, shall be provided with correct safeguarding and insulating features. Suitable roll over protection for the crew shall be provided which shall be consistent with vehicle application, i.e., high speed off-road usage. Vehicle shall comply with all applicable requirements in MIL-STD-1180 for Type I vehicles."*[4]

The HMMWV A2 series specification describes the safety provisions in more detail, as shown below:[5] A2 series HMMWVs shall comply with the requirements of MIL-STD-1180 for Type I vehicles and FMVSS Requirement 216 except as follows:

- Requirement 208, Seat belt warning system is not required.
- Requirement 101, Control illumination shall be as provided for in the TDP.
- Requirement 108, Identification lights shall be as identified in the TDP.
- Requirement 108, Convoy warning light receptacles are not required.
- Requirement 108, Blackout driving light provisions shall be as provided for in the TDP.
- Requirement 111, Inside rearview mirrors are not required.
- Requirement 108, Back-up lamp requirements are only applicable to the M997 A2 Ambulance.
- Requirement 201, Occupant protection shall be as provided in the TDP.
- Requirement 204, Steering control rearward displacement is not applicable.
- Requirement 208, Vehicle crash tests will not be required, however, current performance levels shall not be degraded in the event a change to current vehicle configurations is required.
- Requirement 219, Windshield zone intrusion is not applicable, however, current performance levels shall not be degraded in the event a change to current vehicle configurations is required.
- Requirement 216, Roof crush resistance requirements are not applicable to the M997 A2 ambulance model, however, current performance levels shall not be degraded in the event a change to the current vehicle configuration is required.

Efforts are underway to improve the crew restraint systems and protection of the crew during rollovers. Any fleet-wide changes to improve crew safety in the HMMWV are done

[4] US Army Tank-automotive and Armaments Command, System Specification for HMMWV, 3 February 1983, paragraph 3.3.5.
[5] TACOM, Amendment 1 to System Specification for A2 Block Modification (HMMWV A2), 29 September 1995, paragraph 3.6.2.

under the assumption that users will not modify the vehicle's configuration. In practice, however, users regularly modify the configuration, for example by adding communications equipment or cargo carrying provisions. This reduces the overall effectiveness of safety improvements.

Appendix A
Acronym List

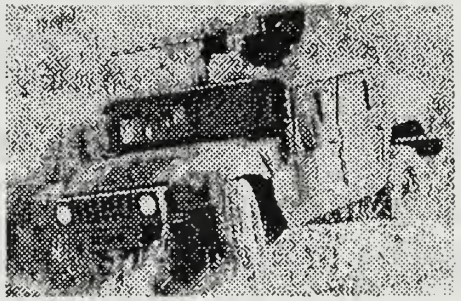
AAE	Army Acquisition Executive
AAN	Army After Next
AAO	Army Acquisition Objective
ACAT	Acquisition Category
AMSAA	Army Materiel Systems Analysis Activity
AOA	Analysis Of Alternatives
APM	Assistant Project Manager
ASL	Authorized Support List
ASV	Armored Security Vehicle
Bhp	Brake Horsepower
CAA	Clean Air Act
CAIV	Cost As an Independent Variable
CBD	Commerce Business Daily
CBITS	Computer Based Interactive Training System
CDLS	Contractor Depot Logistics Support
CEAC	Cost and Economic Analysis Center
CFR	Code of Federal Regulations
CLS	Contractor Logistics Support
COMBATT	Commercially Based Tactical Truck
CPIF	Cost Plus Incentive Fee
CPK	Crew Protection Kit
CUCV	Commercial Utility Cargo Vehicle
DA	Department of the Army
DAE	Defense Acquisition Executive
DCSOPS	Deputy Chief of Staff for Operations
DPM	Deputy Project Manager
DSA	Deputy for Systems Acquisition
DSARC	Defense System Acquisition Review Council
DVD	Direct Vendor Delivery
DoD	Department of Defense
EC	Electronic Commerce
ECV	Expanded Capacity Vehicle
EMI	Electromagnetic Interference
EMP	Electromagnetic Pulse
EPA	Environmental Protection Agency
EPP	Extended Program Plan
ESP	Extended Service Program
ESS	Electric Start System
EUL	Economic Useful Life

FCT	Foreign Comparative Testing
FFP	Firm Fixed Price
FMCSR	Federal Motor Carrier Safety Regulation
FMS	Foreign Military Sales
FMVSS	Federal Motor Vehicle Safety Standard
FOV	Family of Vehicles
FSR	Field Service Representative
GCO	Government Concept of Operations
HAC	House Appropriations Committee
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HMT	High Mobility Trailer
HQDA	Headquarters Department of the Army
IBE	Integrated Business Environment
IDE	Integrated Data Environment
ICLS	Interim Contractor Logistics Support
IETM	Interactive Electronic Technical Manual
IFB	Invitation For Bid
ILS	Integrated Logistics Support
IPPT	Integrated Product and Process Team
IPR	In Process Review
IPT	Integrated Process Team
IROAN	Inspect and Repair Only As Necessary
JMENS	Joint Mission Element Needs Statement
KPP	Key Performance Parameter
LCM	Life Cycle Management
LMTV	Light Medium Tactical Vehicle
LTV	Light Tactical Vehicles
MARCORSYSCOM	Marine Corps Systems Command
MDA	Milestone Decision Authority
MEL	Maintenance Expenditure Limit
MILSTRIP	Military Standard Requisition Processing System
MPA	Military Personnel Army
MWO	Modification Work Order
NAC	National Automotive Center
NEOF	No Evidence Of Failure
NOX	Nitrous Oxide
NSE	National Security Exemption

O&S	Operating and Support
OASA	Office of the Assistant Secretary of the Army
ODC	Ozone Depleting Chemicals
ODCSOPS	Office of the Deputy Chief of Staff for Operations
OPA	Other Procurement Army
ORD	Operational Requirements Document
OSCR	Operating and Support Cost Reduction
OSMIS	Operating and Support Management Information System
PAT	Prototype And Test
PF/DOS	Production, Fielding/Deployment, Operations and Support
PMO	Project Management Office
PM	Project Manager
PM-LTV	Project Manager, Light Tactical Vehicle
POE	Program Office Estimate
POM	Program Objective Memorandum
R&D	Research and Development
RDA	Research, Development and Acquisition
RDT&E	Research, Development, Test & Evaluation
RFP	Request For Proposal
SAG	Study Advisory Group
SI&T	System Integration & Test
SOO	Statement Of Objectives
SOW	Statement Of Work
SPI	Single Process Initiative
STS	System Technical Support
TACOM	Tank-automotive and Armaments Command
TDA	Table of Distribution and Allowances
TDP	Technical Data Package
TO&E	Table of Organization & Equipment
TRAC-Lee	TRADOC Analysis Center – Fort Lee, VA
TRADOC	Training and Doctrine Command
TSM	TRADOC System Manager
TWVM	Tactical Wheeled Vehicle Modernization
ULLS	Unit Level Logistics System
USAF	United States Air Force
USC	United States Code
USMC	United States Marine Corps
WOLF	Work Order Logistics File
WSMR	White Sands Missile Range

Appendix B
Summarized HMMWV AOA SAG Briefing, January 1999

High Mobility Multi-purpose Wheeled Vehicle (HMMWV)



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Analysis of Alternatives (AOA)

Final Report
Scripted Briefing
January 1999

DRAFT

Purpose and Background

To provide analytical underpinning and insights for the Light Tactical Vehicle acquisition strategy.

- 1998 HAC Mark language required that the Army provide an analytical basis for the Light Tactical Vehicle Strategy.
- HQDA requested that TRADOC complete a HMMWV AOA to support FY99 mini-POM submissions.
- Jun 98, HMMWV AOA SAG reviewed study planning for the current analysis.
- Acquisition strategy development, identification of the user's operational requirements and conduct of the AOA proceeded concurrently.

The Challenge

The Army faces three distinct challenges as we manage the light tactical vehicle fleet.

- **Providing the number and mix of systems required by the user.**
- **Sustaining the aging HMMWV fleet.**
- **Satisfying changes in the user's operational requirements.**

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Study Guidance

Study guidance chronology covers a 2 year period.

- **Nov 96 - HMMWV AOA study tasking:**
  - Outlined decision maker issues.
  - Set study parameters.
- **June 97 - AOA based on the Nov 96 tasking put on hold.**
- **Dec 97 - AOA tasking reissued with refined study parameters.**
- **Jun 98 - AOA SAG I approved the analysis approach and directed that the study address:**
  - Aging fleet and Economic Useful Life (EUL) determination.
  - Alternative maintenance strategies.
- **Feb through Dec 98 - Ongoing oversight by DA staff officers.**

Scope

- **The study period is FY00 - FY20.**
- **Addresses variable cost, equal fleet size program alternatives.**
- **Study components include:**
  - A review of the Army's system requirements and the status of the current fleet.
  - Item level performance modeling to determine each unique vehicle's ability to meet operational requirements.
  - An SME assessment of each armored vehicle's ability to meet vulnerability parameters.
  - Fleet comparison of the program alternatives.
- **USMC participation:**
  - Assessment of USMC system requirements and fleet status are beyond the scope of this AOA.
  - ORD includes USMC operational requirements.
  - AOA receive USMC review.

Limitations

- **This AOA does not address:**
  - A "new system" start (ruled out by VCSA in June 97 when the original AOA was put on hold).
  - The impact of armor kit integration on transportability and performance.
  - Evaluation of alternative maintenance concepts:

    PM & TRADOC currently addressing through ORD and Acquisition Strategy review.

    The 20 Oct 98 ORD precluded new maintenance concepts.
  - ORD changes after 20 Oct 98 cutoff date.
- **Descriptive and analytical data for alternative systems limited by the availability of engineering estimates.**

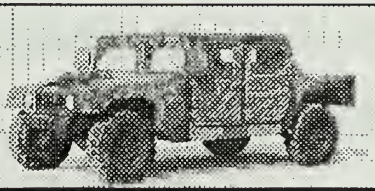
General Assumptions

- TRADOC's 20 October 1998 HMMWV ORD outlines the user's requirements.
- The maintenance strategy for the Army's light tactical wheeled vehicle, stated in the HMMWV ORD, applies across all program alternatives.

> "It will be supported using the current logistics and maintenance structure established for Army wheeled vehicles."
> (ORD for HMMWV, 20 October 1998, page 1, paragraph 1.b.)

- A generically defined commercial vehicle is adequate for comparative analysis.
- Projected technological capabilities are valid.
- Surrogate information adequately represents system capabilities.
- The EUL of the HMMWV is 15 years. (Based on TACOM FPO analysis)

Matrix of Program Alternatives w/System Variants



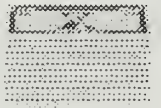
Program Alternative / OMS/MP Category (System Variant)		Base Case Basic HMMWV & Variants (A1, A2) Buy up to AAO. No replacements. Spare parts only.	Excursion 1 Existing Army Vehicle Base Case w / LMTV & ASV as noted.	ALT 1 ESP HMMWV (A3) Recapitalization. Block Mods. ODO back to 0.	ALT 2 A Improved HMMWV (AX) Commercial technology from COMBATT Program.	ALT 2 B Commercial Vehicle	ALT 3 Hybrid REMAN HMMWV (A4) 6-year life extension.	ALT 4 PM LTV's Strategy Jun-98 Combine Alt 2A & 3	ALT 4 PM LTV's Strategy Dec-98 Combine Alt 2A & 1
Standard	Cargo/ Utility/ Howitzer-towing	M998 M1038 M1097	See Base Case w / M1078 (LMTV)*	M998 M1038 M1097	M1097 M1113*	Com Trk	M998 M1038 M1097	Maintain HMMWV Production + Extend life of selected HMMWVs	Maintain HMMWV Production + Capture best of ESP & REMAN costed as pure ESP
	Ambulance	M996 M997	See Base Case	M996 M997	M997	Com Trk	M996 M997		
Shelter Carrier		M1037 M1097 M1113	M1078 (LMTV)	M1037 M1097 M1113	M1113	Com Trk	M1037 M1097 M1113		
Armament Carrier	Light	M966 M1025 M1026	XM1117 (ASV)	M966 M1025 M1026	XM1114	RG-31	M966 M1025		
	Up-Armored	XM1114		XM1114			XM1114		

* Replacement system for Light/Heavy Howitzer towing mission.

HMMWV AOA Study Approach

Study Agency - TRAC-LEE

Assess PM's LTV Acquisition Strategy
Requirements, Performance, Costs, MPT, & Logistics Impacts
All Study Participants

Force Assessment	System Assessment	Fleet Comparison
• System Requirements • HMMWV EUL • Current Fleet Status	• Item Level Analyses • Ability to meet ORD • Performance Drivers	• Maintenance manpower • Costs
		
TACOM - FPO TWVRMO TRAC-LEE	AMSAA	TRAC-LEE & WSMR

Define the Alternatives
HQDA, PM LTV, & TACOM

Literature Search
Historical Information, EPA & Safety
Armor Requirements
All Study Participants

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Analyses

- Force requirements and fleet status assessment.
- Item level analyses of current HMMWV variants & potential replacement systems.
- Fleet analyses of program alternatives.

Force Requirements & Fleet Status

- **Requirements:**

FY 2003	FY 2005	FY 2010
121,692	121,454	121,454

- **Systems on-hand: 102,784**
  - FUE: 1985
  - Approximately 19k additional vehicles needed to fill the requirement.
  - Changing requirements result in fleet imbalance, i.e.:

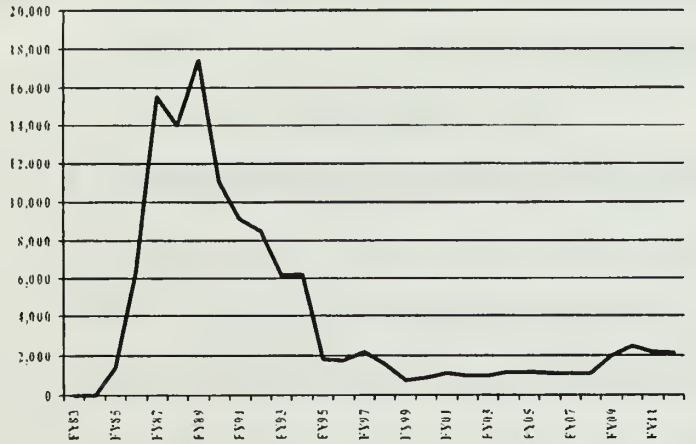
    M1025/A1/A2: Approximately 12,500 on-hand, 760 required.

    XM1114: Approximately 1500 on-hand, 7,500 required.

- **Condition: Low-mileage but aging.**
  - Mileage: 47% report less than 16k accumulated odometer miles while 4% report more than 50k.
  - Age: 53% of fleet is 9 years or older.
  - User perceptions: Approximately 2/3 of the fleet in excellent/good condition.
  - Projections: Repair costs expected to increase.

HMMWV Fleet, Projected Conditions

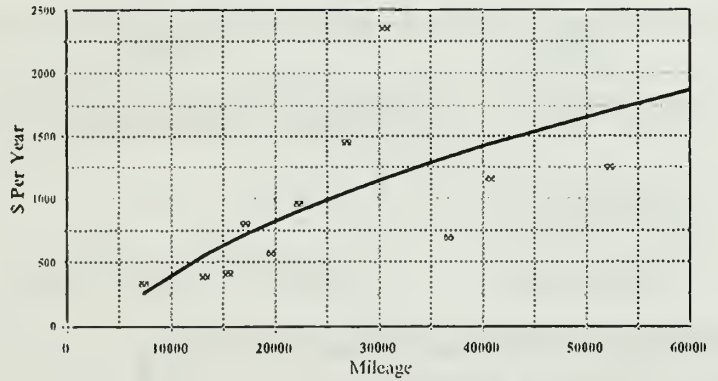
Quantities Procured by Year



120

Parts cost per vehicle average 250% more for 11 year old high mileage vehicles compared to 5 year old vehicles.

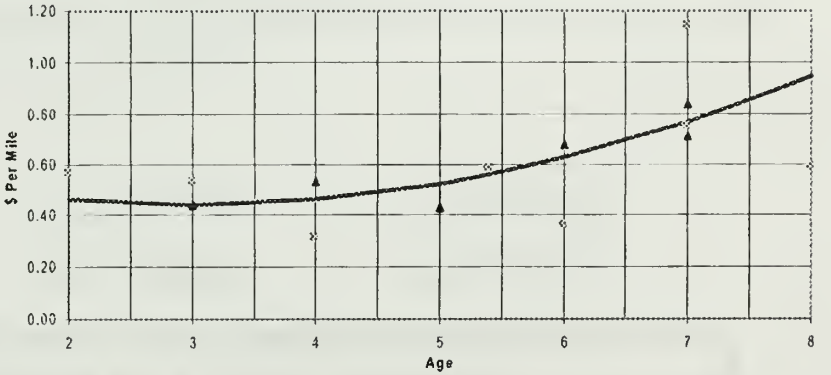
Repair Cost vs. Mileage



*Includes Tire Cost

Source: Central Demand Data Base (CDDB)

Repair Cost vs. Age



Source: Sample Data Collection 1989-1993

Item Level Assessment

Payload and transportability are key performance drivers.

- **Ability to meet Requirements:**
  - Standard Mission.

    M998s meet all requirements except payload.

    M1097s provide additional payload with reduced mobility.

    Commercial vehicles provide adequate payload; however -

    Do not meet mobility and air transport requirements.
    Concern about Mission Profile for determining R & M.
  - Shelter Carrier: Need for further tradeoff analysis indicated (payload, towed load and mobility vs. transportability).
  - Armament Carrier: HMMWV variants satisfy most requirements.
  - RG-31 and ASV provide protection but raise mobility, transportability, and R&M concerns.
- **Risks and potential tradeoffs.**

Best Performing Systems w/ Risks & Tradeoffs

Shelter Carrier

Risk Definition
Low - difference transparent to user
Medium - noticeable difference
High - affects mission accomplishment

- **Best Alternative / Advantages: XM1113**
  - Meets 97% of payload and 93% towed load requirements.
  - Meets all transportability except number of vehicles in one C-130.
- **Limitations:**
  - Slightly reduced payload and towed load. Operational Risk: Low
  - Decreased mobility. Operational Risk: Medium
  - Lower reliability & higher maintenance ratio. Operational Risk: High
- **Potential tradeoffs:**
  - Accept small decrease in payload for good transportability.
  - Accept no towed load growth potential.
  - Accept decreased mobility and R&M.

Best Performing Systems w/ Risks & Tradeoffs

Shelter Carrier (continued)

Risk Definition
Low - difference transparent to user
Medium - noticeable difference
High - affects mission accomplishment

- **Best Alternative / Advantages: LMTV**
  - Meets 100% payload and towed load.
  - Exceeds range and reliability requirements.
  - Can meet LVAD transportability requirement (LMTV M1081 air drop version).
- **Limitations:**
  - Decreased mobility. — Operational Risk: Medium
  - Too tall to meet C-130 roll on/ roll off (RO/RO) IAT w / shelter. — Operational Risk: High
  - Too heavy for CH-47D & UH-60L EAT. — Operational Risk: High
- **Potential tradeoffs:**

  LMTV:
  - Reassess C-130 RO/RO IAT w / shelter requirement (separate shelter).
  - Consider collapsible shelter program.
  - Reduce weight and/or payload to meet CH-47D & UH-60L EAT.

Best Performing Systems w/ Risks & Tradeoffs

Shelter Carrier (continued)

Risk Definition
Low - difference transparent to user
Medium - noticeable difference
High - affects mission accomplishment

- **Best Alternative / Advantages: LMTV**
  - Meets 100% payload and towed load.
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  - Can meet LVAD transportability requirement (LMTV M1081 air drop version).
- **Limitations:**
  - Decreased mobility. Operational Risk: Medium
  - Too tall to meet C-130 roll on/ roll off (RO/RO) IAT w / shelter. Operational Risk: High
  - Too heavy for CH-47D & UH-60L EAT. Operational Risk: High
- **Potential tradeoffs:**

  LMTV:
  - Reassess C-130 RO/RO IAT w / shelter requirement (separate shelter).
  - Consider collapsible shelter program.
  - Reduce weight and/or payload to meet CH-47D & UH-60L EAT.

Best Performing Systems w/ Risks & Tradeoffs

Armament Carrier (Light & Up-Armored)

Risk Definition
Low - difference transparent to user
Medium - noticeable difference
High - affects mission accomplishment

- **Best Alternative / Advantages: XM1114**
  - Meets 100% payload (light weapon carrier).
  - Meets 93% payload (heavy weapon carrier).
  - Meets transportability requirements.
  - Provides some armor protection.
- **Limitations:**
  - Reduced payload (heavy). Operational Risk: Medium
  - Decrease in mobility. Operational Risk: Low / Medium
  - Lower reliability and higher MR than baseline HMMWV. Operational Risk: Medium / High
  - Fails 155mm artillery and AT mine protection. Operational Risk: Medium / High
- **Potential Tradeoffs:**
  - Accept slightly reduced payload for the heavy mission.
  - Accept decrease in R&M.
  - Reassess vulnerability and armor protection requirements.

Best Performing Systems w/ Risks & Tradeoffs

Armament Carrier (Light & Up-Armored) (continued)

Risk Definition
Low - difference transparent to user
Medium - noticeable difference
High - affects mission accomplishment

- **Best Alternative / Advantages: ASV**
  - Meets 100% payload and armor protection.
  - Is transportable in C-130 @ GCW.
- **Limitations:**
  - Poor mobility (low power to weight ratio). Operational Risk: High
  - Fails EAT and LVAD requirements. Operational Risk: High
  - Lower reliability & higher MR than HMMWV. Operational Risk: High
- **Potential Tradeoffs:**
  - Accept decrease in mobility and R&M.
  - Reassess ORD EAT and LVAD requirements.

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System Performance Summary

- **Current systems** (HMMWVs / Hybrid REMAN):
  - Payload is the performance driver.
  - Weight growth increasing risk of meeting mobility, transportability and R&M requirements.
- **Commercial technology** (HMMWV (ESP/ Improved) or COM TRK):
  - M1097A2 represented an Improved HMMWV.
  - Com Trk meets standard payload & R&M but is high risk for remaining requirements.
- **Other Army systems** (LMTV & ASV):
  - Meet payload & armor requirements.
  - Not externally air transportable.

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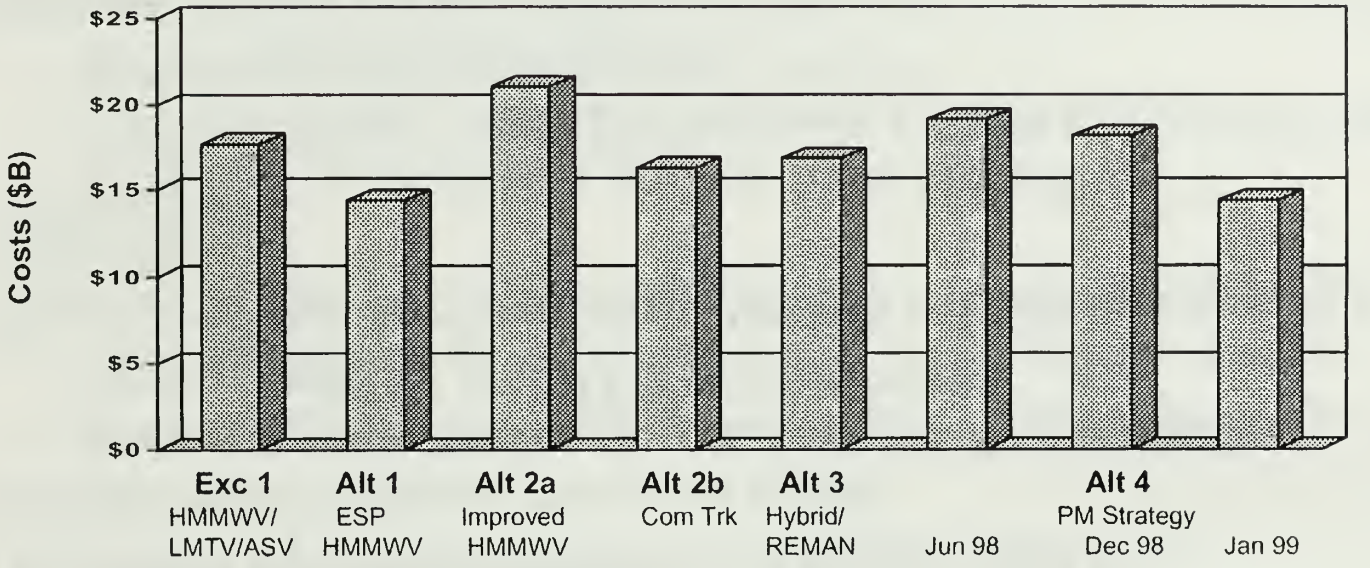
Life Cycle Cost Summary

20-year LCC, Program Alternatives
(Procure shortfall, upgrade, replace, & sustain)



Appendix C
Acquisition Strategy Report Briefing, 25 January 1999

TACOM

Mobility and Firepower
for America's Army

U. S. Army

Acquisition Strategy Report
for
Light Tactical Vehicles (LTV)
by
PM LTV

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"Putting more *Hum* in the HMMWV!"

Nancy A. Moulton
Project Manager, Light Tactical Vehicles

25 January 1999

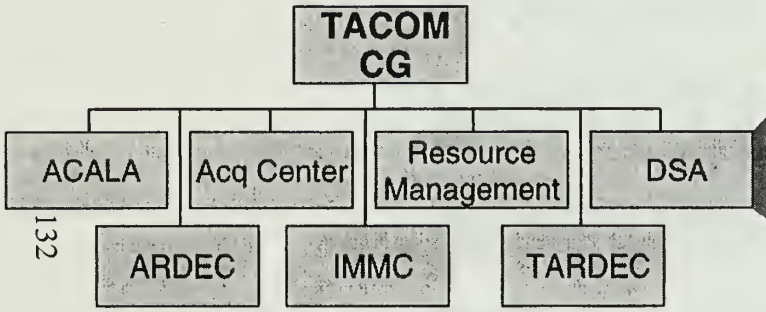
Briefing Outline

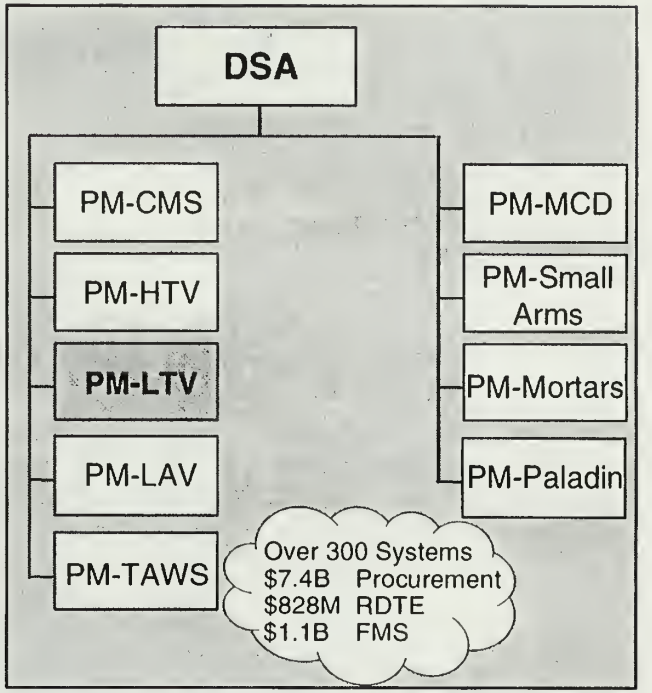
- HMMWV Fleet Status
- Service Life
- Requirements
- AOA Summary
- Analysis of AOA
- PM LTV Acquisition Strategy
- Summary
- Plan of Action
- Recommended Decisions

Where We Fit in the Tank-automotive & Armaments Command (TACOM)

TACOM Mission

- To Generate Warfighting Capability for the Army
- To Sustain the Warfighting Readiness of the Army
- To Manage the Army's Investment in S&T, R&D and Sustainment for the Army
- Serve as the Life Cycle Manager and Integrator for Ground Combat Equipment





TACOM VISION

To make the technology and sustainment systems work for soldiers through the seamless integration of S&T, R&D, Acquisition, Log Sustainment and Soldier Readiness

To create a business environment at TACOM where every associate understands the requirement to control costs and manage from the customer perspective and understands their inherent responsibility to do so.

Tank-automotive & Armaments Command

Research, Develop, Field and Support Mobility and Armaments Systems Total Life Cycle

To Support Army Readiness

Combat Vehicles
Tactical Vehicles
Trailers
Construction Equipment
Materiel Handling Equipment
Tactical Bridges
Fuel & Water Distribution Eqpt
Sets, Kits & Outfits
Shop Equipment
Chemical Defense Equipment
Howitzers
Large Caliber Guns
Mortars
Rifles
Machine Guns
Ammo
Aircraft Armaments
Demolitions & Explosives
Rail
Watercraft
Petro & Lub Eqpt

High Mobility Multipurpose Wheeled Vehicle (HMMWV)

Description

- Primary light wheeled vehicle for Army
- Multiple configurations - cargo/utility, shelter carrier, ambulance, armament carrier, up-armored
- Prime mover for many combat, signal, intelligence systems
- Over 100,000 fielded to virtually every MTO&E unit

Performance/Features

- Top speed 55 mph+
- Max grade 60%, side slopes 40%
- Ground clearance 16 inches
- Payload 2,250 - 5,100 lb. depending on variant

Requirements

- AAO: 121,692 (45,474 FP1&2; 76,218 FP3&4)
  USMC: 18,582 USAF: 3,790
  Navy: 585 FMS: 9,769 Army: 103,418

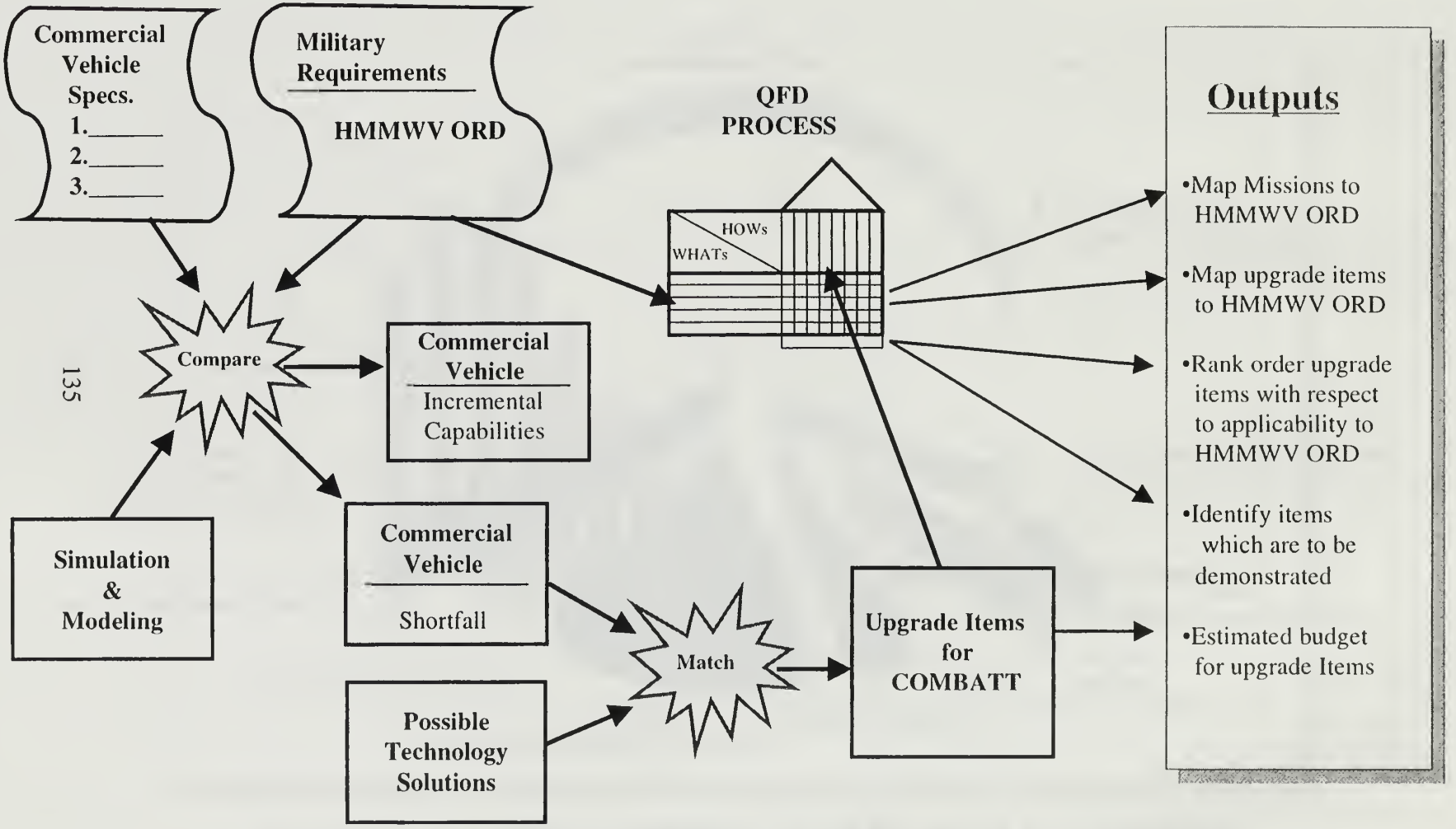
O&O/ORD

- JMENS 8 Jul 80
- Hvy Up-Armored HMMWV approved 19 Sep 93
- HMMWV II ORD approved Dec 97 by TRADOC
- Updated HMMWV ORD 20 Oct 98

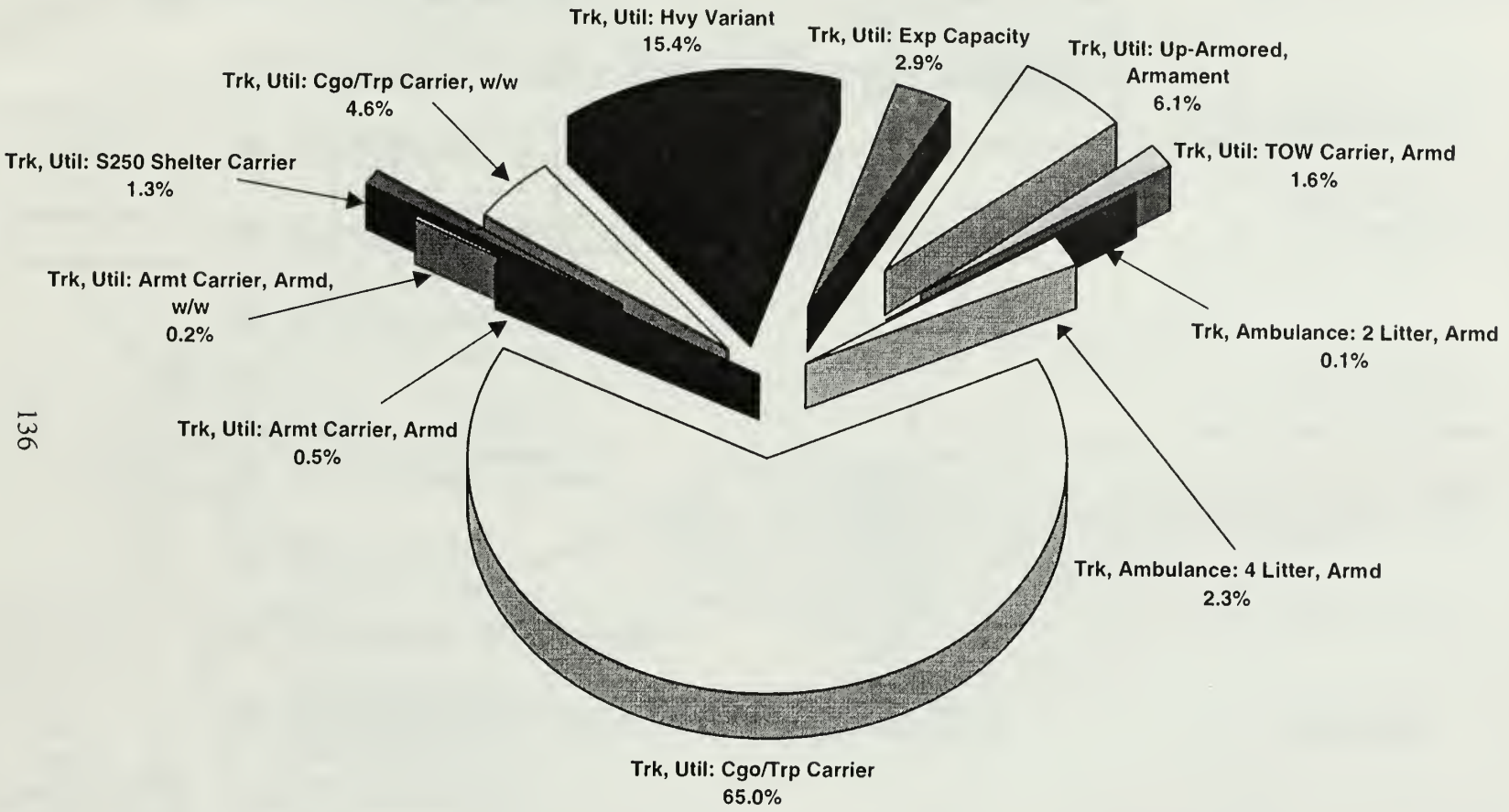
Requirements

- HMMWV ORD
  - Standard Mission = Cargo/Utility
  - Shelter Carrier Mission
  - Armament Carrier Mission
  - Ambulance
- KPPs
  - Payload
  - Mobility
  - Transportability
  - Reliability and Maintainability
- Vulnerability
- CP IPT using CAIV process to evolve ORD KPP thresholds and objectives

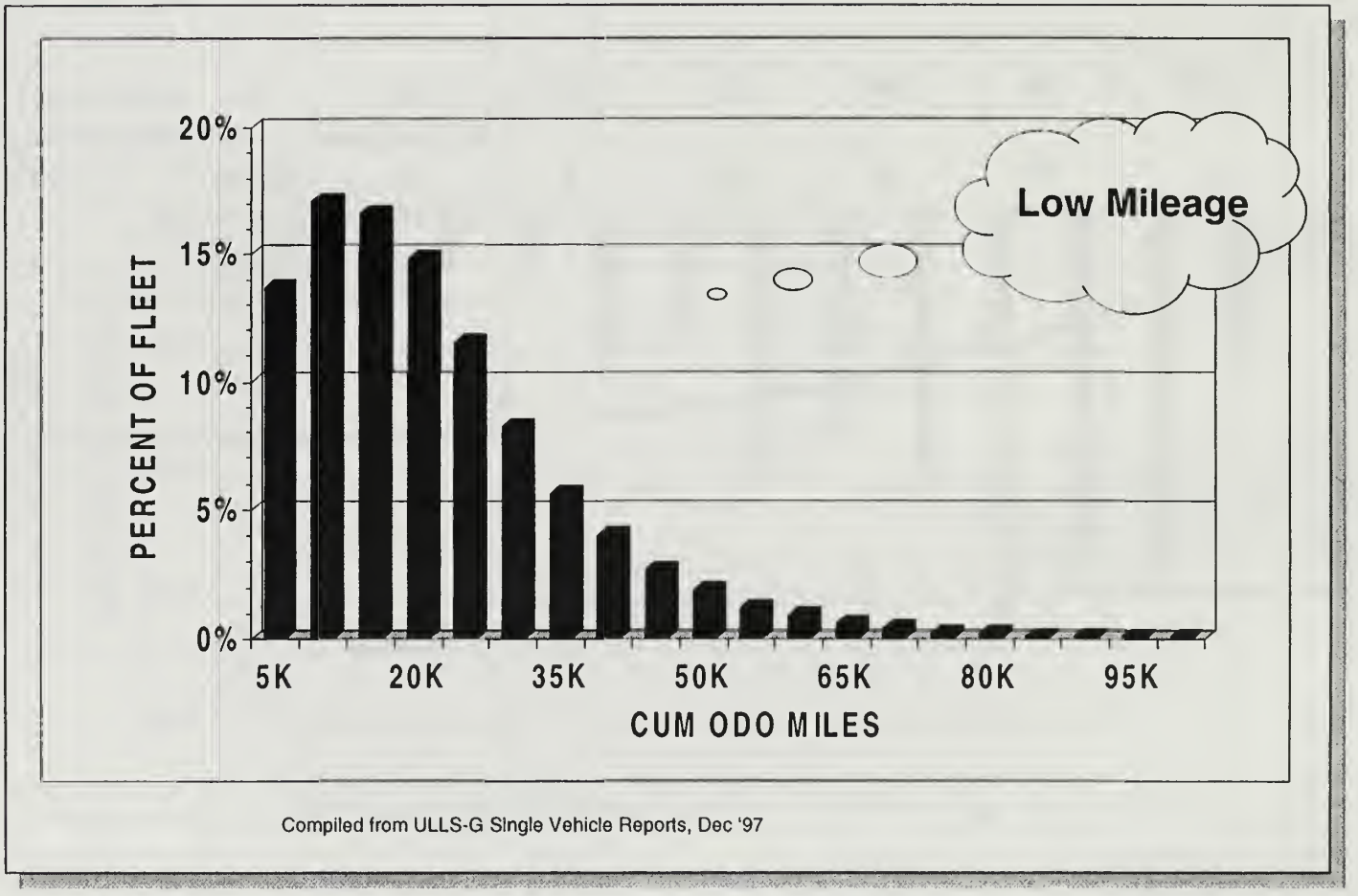
Requirements & Analysis Process



Army Acquisition Objective Totals

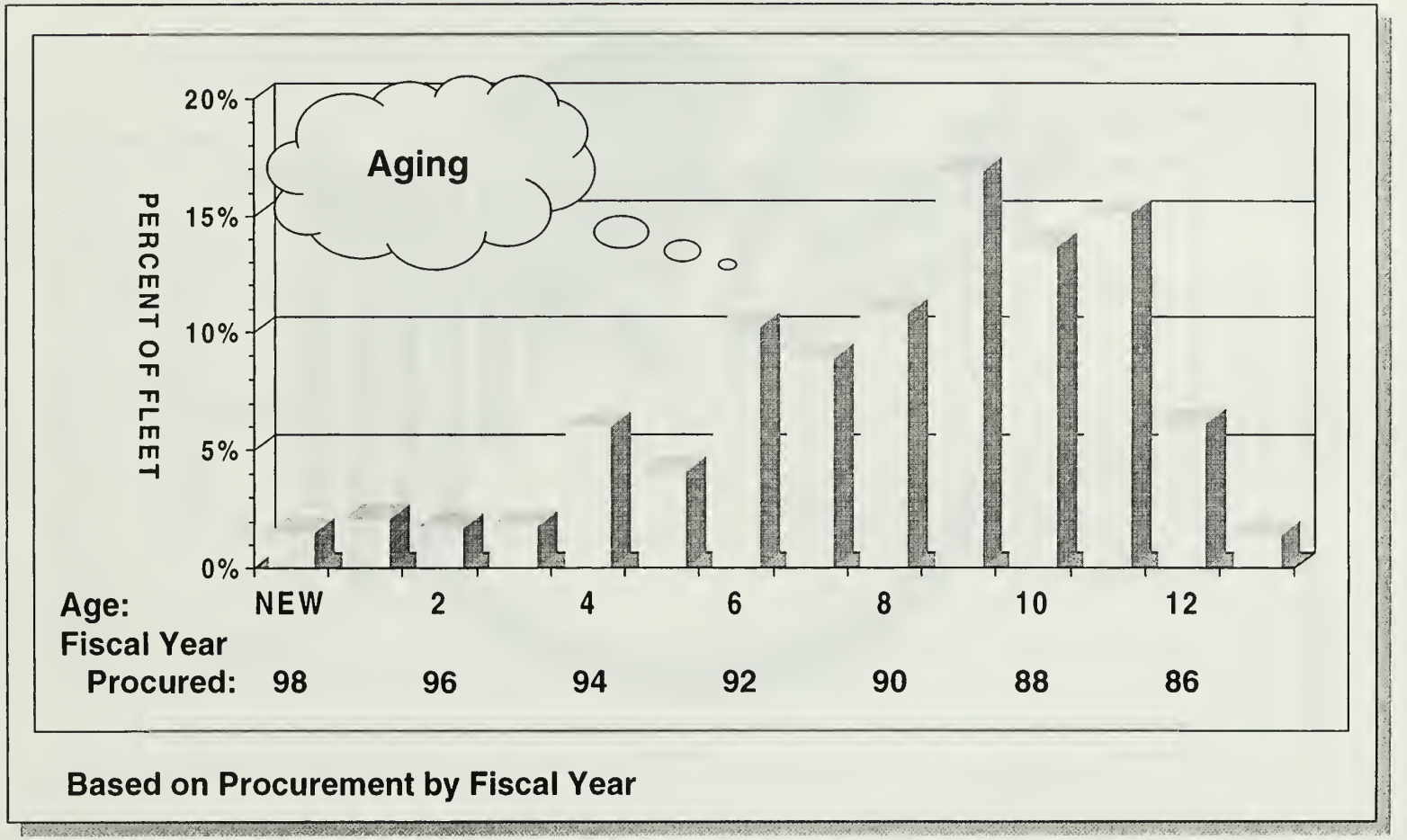


HMMWV Fleet, Cumulative Odometer Mileage



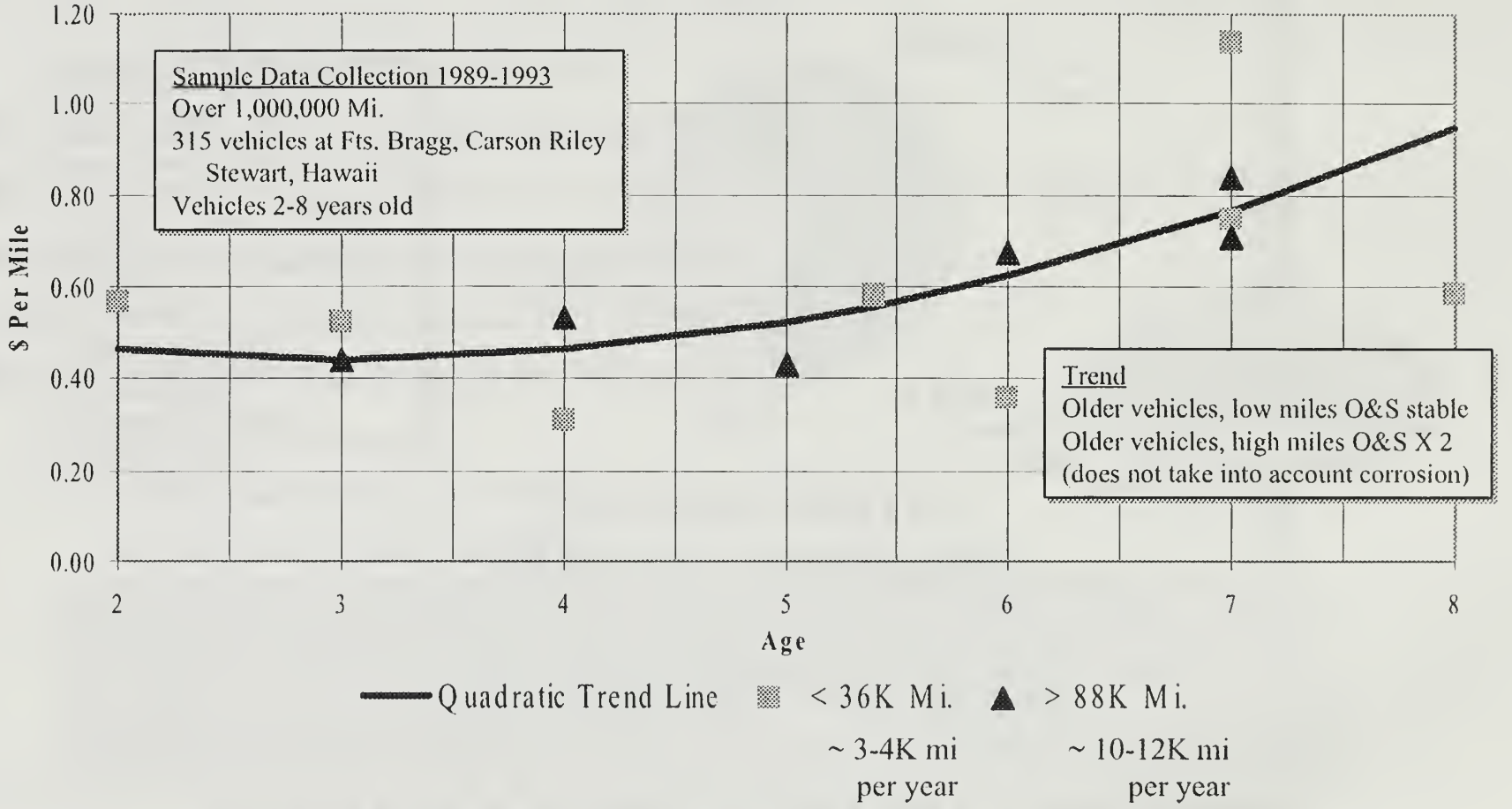
Compiled from ULLS-G Single Vehicle Reports, Dec '97

HMMWV Fleet, Age of Inventory



Repair Cost vs. Age

Projected HMMWV Cargo - Maintenance Cost

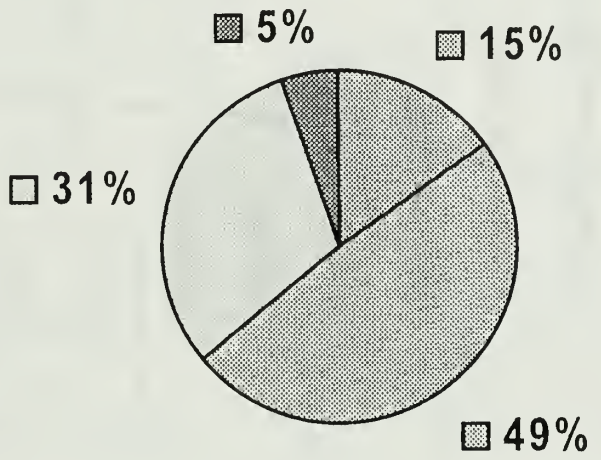


HMMWV Fleet, Current Condition

User/Maintainer Survey Results

Survey Summary
- TACOM Soldier Spt Network voluntary data call in Summer, 1998
- 49 units responded
- ~3,400 vehs included

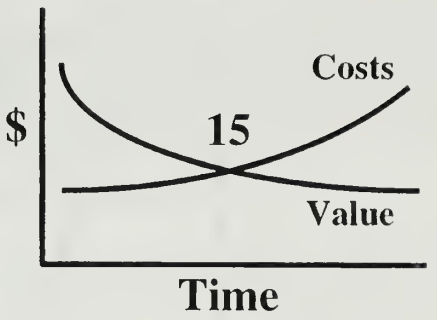
Definitions
- Excellent - Condition, Perf. like new
- Very Good - Perf. to specs in 10/20 condition
- Fair - Operational but several areas below 10/20
- Poor - Extensive wear, deterioration, poor perf.



64% Good Condition

HMMWV Service Life Analysis

- EUL projection is now at 15 years based on O&S drivers analysis, maintenance data analysis, sample data collection
- Corrosion protection possible to 22 yrs
- Current average O&S cost per mile is 45¢
- OSMIS data indicates top cost drivers are engines, tires, generators ($21M/year)
- EUL alone is not enough to determine end of service life
  - Other factors: Age, Mileage, Corrosion, MEL, O&S Cost Burden

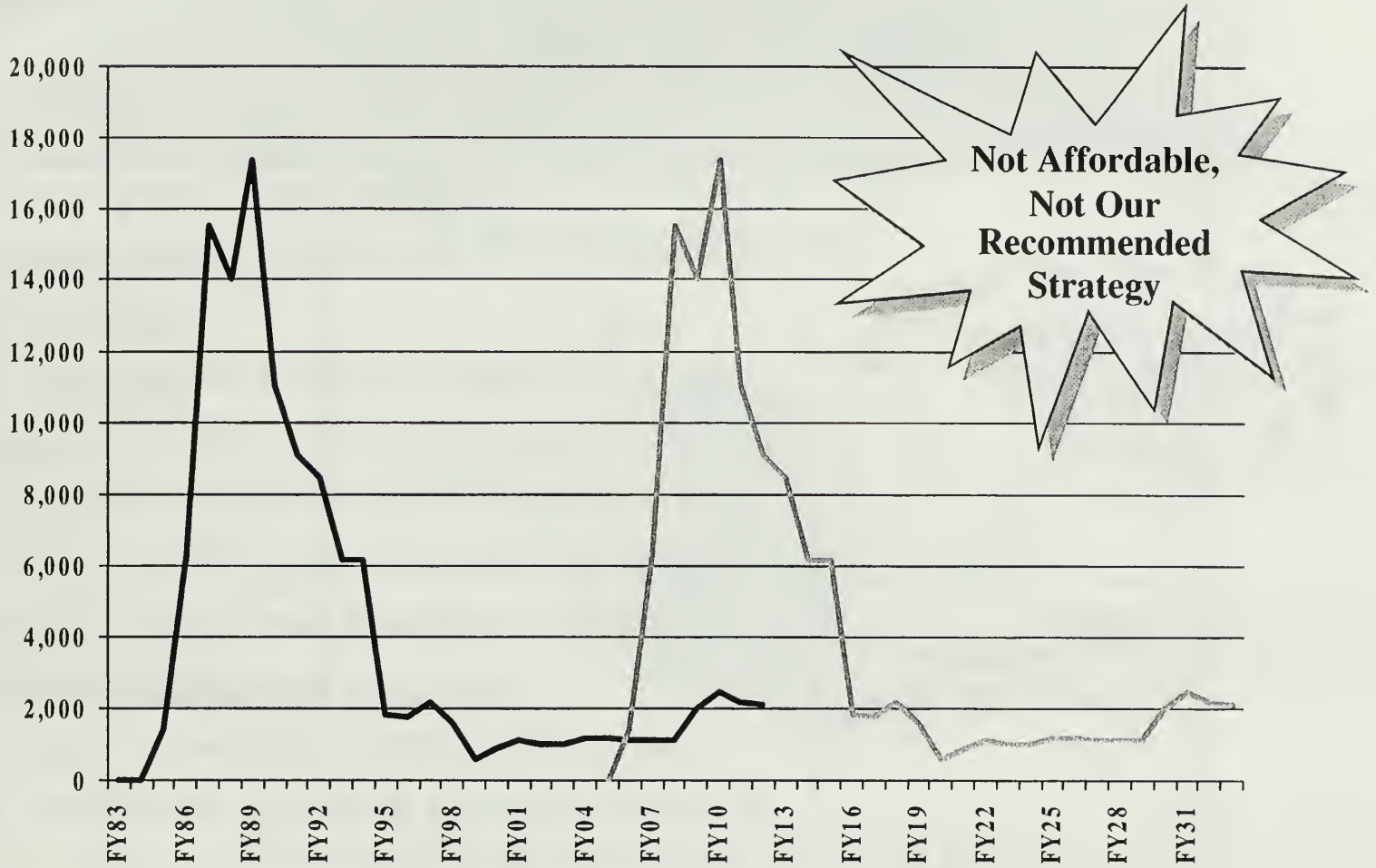


MTS and Tech Insertion initiatives will extend life & reduce O&S costs

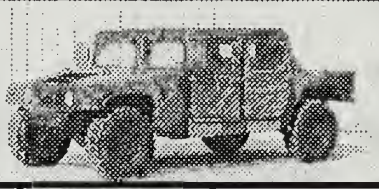
Based on the Fleet Planning projections, Army requirements are not met with current funding levels.

Quantities Procured by Year

Replacement After 21 Years



Matrix of Program Alternatives w/System Variants



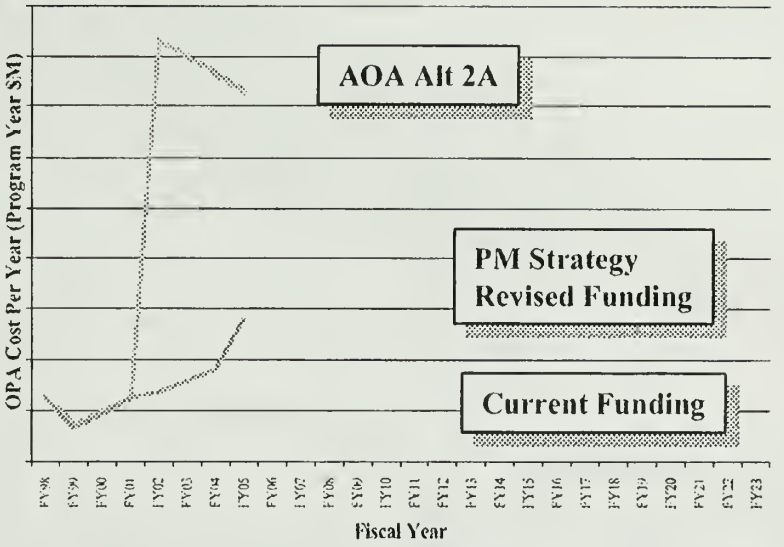
Program Alternative / OMS/MP Category (System Variant)		Base Case: Basic HMMWV & Variants (A1, A2) — Buy up to AAO — No replacements — Spare parts only	Excursion 1: Existing Army Vehicle	ALT 1: ESP HMMWV (A3) — Recapitalization — ODO back to 0	ALT 2: A — Improved HMMWV (AX) — Commercial technology from COMBATT Program	ALT 2: B — Commercial Vehicle	ALT 3: Hybrid REMAN HMMWV (A4) — 6-year life extension	ALT 4: PM LTV's Strategy — Jun-98: Combine Alt 2A & 3	ALT 4: PM LTV's Strategy — Dec-98: Combine Alt 2A & 1
Standard	Cargo/ Utility/ Howitzer-towing	M998 M1038 M1097	M1078 (LMTV)*	M998 M1038 M1097	M1097 M1113*	Com Trk	M998 M1038 M1097	Maintain HMMWV Production + Extend life of selected HMMWVs	Maintain HMMWV Production + Capture best of ESP & REMAN costed as pure ESP
	Ambulance	M996 M997	NA	M996 M997	M997	Com Trk	M996 M997		
Shelter Carrier		M1037 M1097 M1113	M1078 (LMTV)	M1037 M1097 M1113	M1113	Com Trk	M1037 M1097 M1113		
Armament Carrier	Light	M966 M1025 M1026	XM1117 (ASV)	M966 M1025 M1026	XM1114	RG-31	M966 M1025		
	Up-Armored	XM1114		XM1114			XM1114		

* Replacement system for Light/Heavy Howitzer towing mission.

AOA Results

Requirements & Fleet Status

- Requirements:
  - 121 K systems required.
  - 103 K systems on - hand.
  - 18 K additional systems needed.
  - Fleet imbalance (mix of systems).
- Fleet Status:
  - Aging but low-mileage
  - Most perceived to be in good condition
  - Age related increase in O&S costs projected

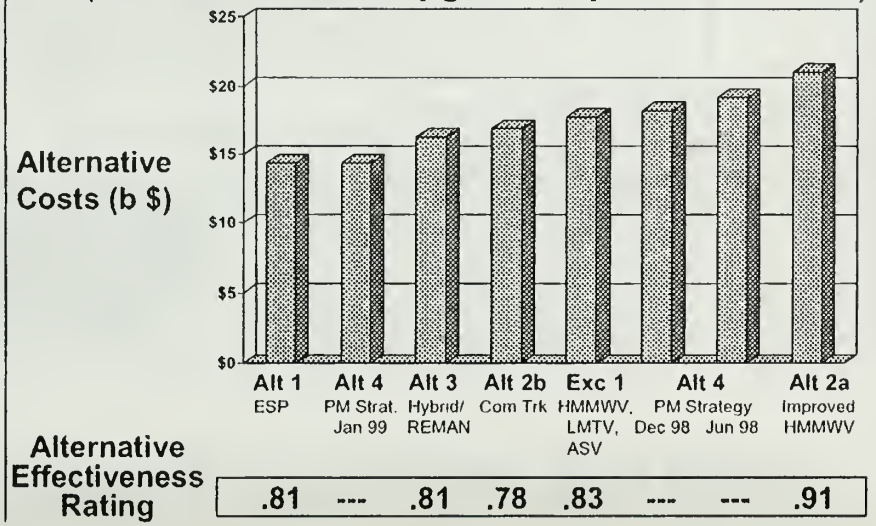


System Performance

- Current systems (HMMWV variants):
  - Best choice: meets most requirements
  - Payload is limited for shelter missions
  - Weight growth increasing risk of meeting transportability KPP in future
- Commercial technology:
  - Com Trk meets payload & R&M, but is high risk for the remaining KPPs.
- Other Army systems (LMTV & ASV):
  - Meet payload & armor requirements well for selected missions.
  - Not transportable (EAT).

20-year LCC vs Effectiveness

(Procure shortfall, upgrade, replace, & sustain)



Evaluation of Results

Summary

- **Parallel effort by PM-LTV and TRADOC finds:**
  - **Only alternative that has potential to meet ORD requirements for Force XXI is "Improved HMMWV"**
  - **Commercial truck, LMTV and ASV alternatives are not acceptable to the user because they do not meet critical requirements**
  - **Recapitalization should be pursued only if there is not enough funding to buy only "Improved HMMWVs"**
  - **Potential cost avoidance with Recapitalization**

Light Tactical Vehicle
Life Cycle Management (LTV LCM) Strategy

- **Objectives**
  - **Recapitalize our initial investment in the aging fleet**
  - **Maintain production**
  - **Modernize the fleet to focus on Army and Joint Vision goals**

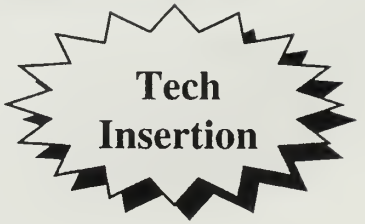
- **Assumptions:**
  - **No "leap ahead" technologies now or in near term render the HMMWV obsolete**
  - **The HMMWV is the basic light tactical vehicle for Army XXI**
  - **No new start or follow-on developmental system is needed until Army After Next**
  - **A stable funding stream is maintained**
  - **Remains an ACAT III Program**

LTV LCM Strategy Features

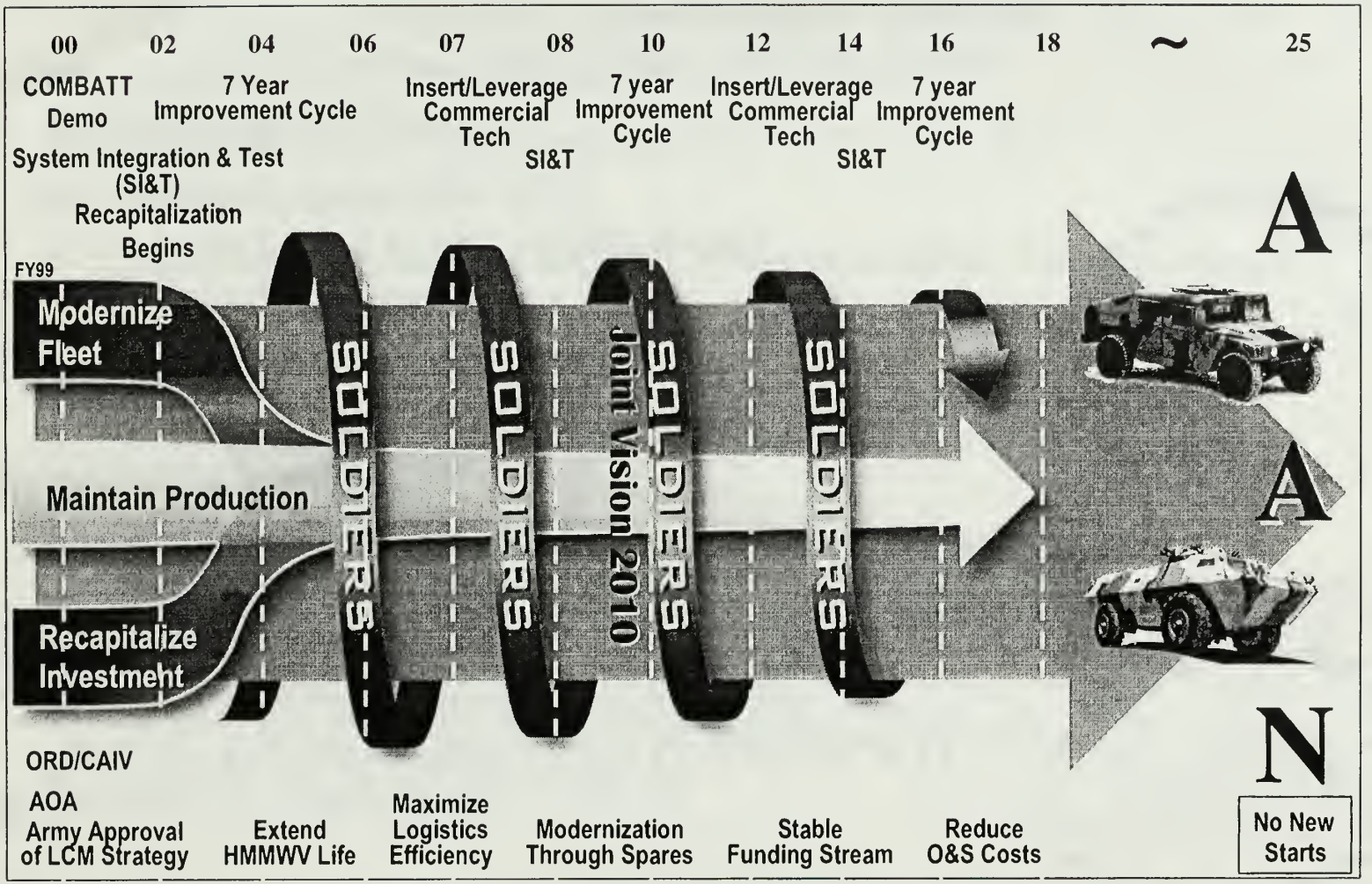
- *Recapitalize the Fleet:*
  - Goal: Extend the service life by additional 21 years
    - Leverage off previous investment
    - Recoup residual value
    - Extend life of the legacy by improving RAM and corrosion protection

- *Maintain Production:*
  - Maintains HMMWV production for AAO requirements:
    - Replacement vehicles
    - Heavy variants
    - USMC and USAF requirements
    - Spares for legacy fleet

- *Spiral Modernization:*
  - Leverages Commercially Based Tactical Truck (COMBATT) technology demonstration program
    - Insert commercial technologies
    - Meet Army XXI, legislative requirements



PM-LTV Strategy
Spiral Modernization



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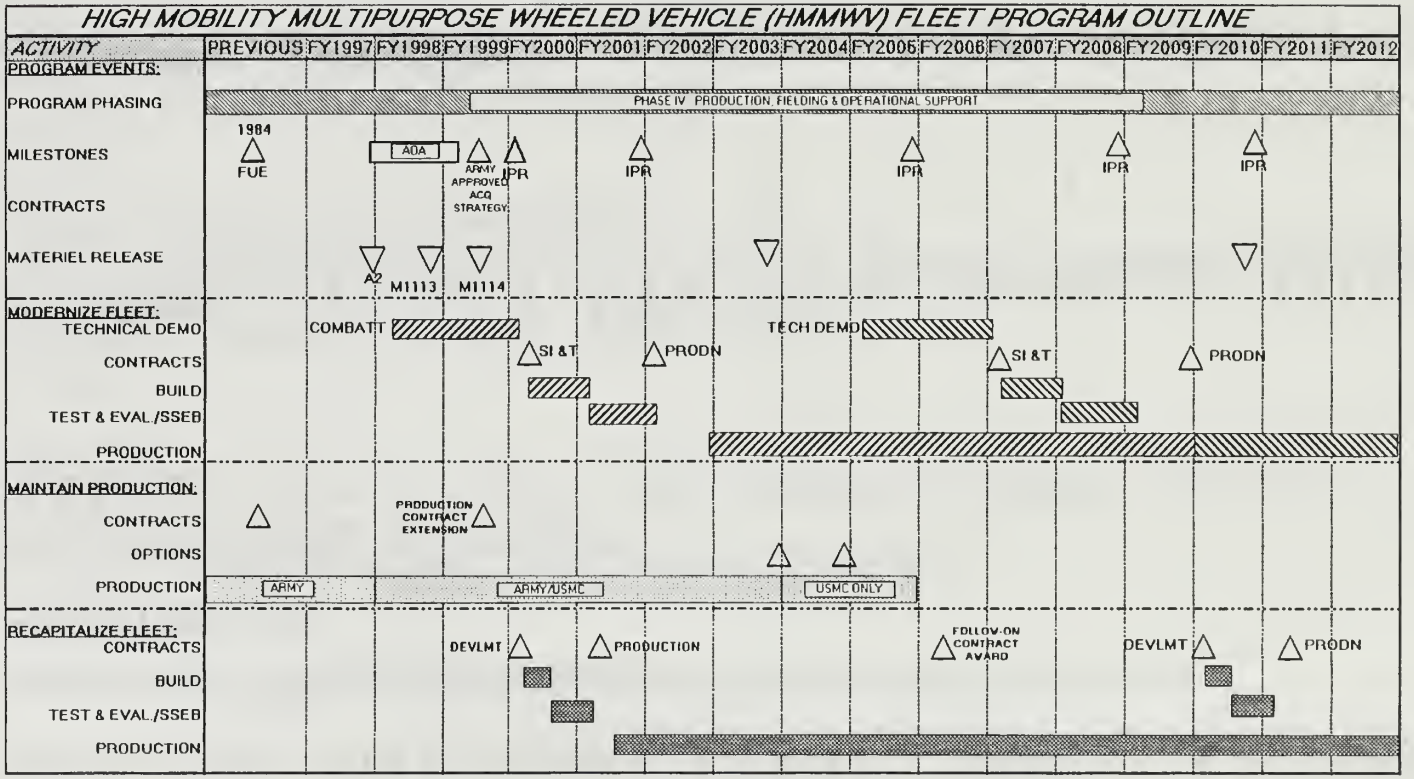

Key Strategy Enablers

- ✓ User Focus
- ✓ Partnership with Customer, TARDEC, Industry, Academia
- ✓ Integrated Data Environment/Integrated Business Environment
- ✓ Simulation and Modeling
- ✓ OSCR
- ✓ CAIV
- ✓ Evolutionary Logistics - MTS, Focused Sustainment, IETMS, DVD, IMMC Involvement
- ✓ EVM
- ✓ Paperless Contracting
- ✓ Innovative Thinking - Like-Kind Exchange

Summary

- PM LTV has built the Acquisition Strategy on the AOA and other complementary analyses
- LTV Acquisition Strategy w/AOA, due to Congress with the budget submission per their request
- PM LTV Strategy offers best solution to today's known requirements at the lowest life cycle cost

Coordination

- ✓ **Briefed and gained TACOM DSA approval (Milestone Decision Authority)** — **11 Jan**
- ✓ **Completed Acquisition Strategy** — **12 Jan**
- ✓ **Obtained HQDA staff feedback** — **14 Jan**
- ✓ **Briefed and gained CG TACOM concurrence** — **15 Jan**
- ✓ **Briefed and gained AMC, DCSOPS, SARDA concurrence** — **19 Jan**
- ✓ **Briefed and gained concurrence:** — **22 Jan**
  LTG Kern, Dr. Oscar, MG Franklin, MG Cosumano, Mr. Charles, Dr. Fallin, Dr. Hinkle, Mr. Hill
- ✓ **Decision brief to Mr. Hoeper (AAE), gained approval** — **25 Jan**
- ✓ **Briefed and gained OSD concurrence:** — **26 Jan**
  Director, Strategic & Tactical Land Systems; OSD Comptroller representative

Appendix D
Description of HMMWV AOA Alternatives

Alternative 1
EXTENDED SERVICE PROGRAM

Scope: This alternative conducts an Extended Service Program (ESP) to extend the life of existing, aging HMMWVs to "Age 0" through a combination of refurbishment, component replacements, and addition of the latest technology where appropriate. It is part of the PM-LTV Life Cycle Management strategy to recapitalize the HMMWV fleet by using available funds to preserve and enhance past investments.

General Description: The objectives of this program are to extend the useful service life of, and provide operational and safety improvements to, the oldest vehicles in the HMMWV fleet. For the AOA, these vehicles will have the "A3" model designation. This designation applies only to the AOA and does not affect any HMMWV model designations which are part of the LTV Life Cycle Management (LCM) acquisition strategy. For performance and cost modelling, this alternative will be represented by the M998A3. This will be achieved by a combination of component refurbishment and replacement. Selected components which have been improved during the evolution of the HMMWV will be incorporated in the vehicles where technically and economically feasible. The program would include improvements to make the vehicles more resistant to the effects of corrosive environments. This alternative is based on a previously funded program to remanufacture HMMWVs as a bridge until a "next generation" HMMWV is developed. The program envisioned a nearly one for one ratio of vehicles inducted to vehicles produced. See the attached Vehicle Comparison Matrix for ratings of this alternative against the ORD requirements.

Vehicle Requirements:

The HMMWV ESP will produce vehicles of all variants which are in the current HMMWV fleet. They will operate on JP8 fuel; be capable of being towed, performing self-recovery, recovering equivalent vehicles and will mount a tow pintle for towing designated trailers. These vehicles shall be capable of operating under on-road/off-road conditions and must withstand equivalent strain, shock, vibration and other detrimental conditions incident to off-road travel and operation as the original HMMWVs. The vehicles shall be capable of meeting all performance characteristics under a typical life cycle mileage profile consisting of 30% primary roads, 30% secondary roads, and 40% cross country operations, while carrying and towing specified loads. Vehicles will have the following performance characteristics equivalent to the HMMWV: mobility; tires; operating temperatures; emissions; payloads; transportability characteristics; communications equipment.[6]

Vehicles shall be disassembled, inspected and their usable components cleaned and/or refurbished. Parts that are not economical to repair shall be replaced with new parts in accordance with the applicable technical data package. All components normally replaced based

[6] HMMWV Remanufacture Program Single Acquisition Management Plan (SAMP) (Draft), Section III.A.

on wear or at regular intervals (time or mileage) as specified in the applicable technical manual shall be replaced regardless of condition. Vehicles with new engines shall comply with Environmental Protection Agency regulations governing control of air pollution from New Motor Vehicles and New Motor Vehicle Engines in effect on the date of contract award. Vehicles with remanufactured or IROANed engines shall comply with the regulations applicable at the time of engine manufacture.[7]

Some of the major components, modifications, and upgrades are as follows:[8]

- De-tuned 6.5L V8 Engine
- Rebuilt or IROAN 3 speed Automatic Transmission
- New Radiator with Improved Heat Rejection
- Improved Corrosion Resistant Exhaust System
- Higher Air Flow Air Cleaner Element
- Dual Voltage 100 Amp Alternator (replaces 60 amp alternator)
- West Coast Style Mirrors
- A2 Style Bucket Seats
- 3-Point Seat Belts
- Higher Capacity, 3 1/2 Ton Jack.
- Serpentine Belt System
- New half shafts and Heavier Duty Ball joints
- Radial Tire and Wheel Assembly
- Low Profile Run-flat Assembly
- Upper Control Arm Assembly (with encapsulated ball joint mounting)
- 242 Transfer Case
- Metal Grille
- Flexible Brake Lines at the Calipers
- Improved Corrosion Resistance
- Improved Engine Starting System
- Dual Voltage 200 Amp Alternator for Ambulance

[7] HMMWV Remanufacture Program System Specification (Draft), 12 Sep 97.
[8] HMMWV Remanufacture Program SAMP, Section VII.A.3.

Alternative 2A
BUY IMPROVED HMMWV

Scope: This alternative procures HMMWVs which are improved versions of the current series of A2 model vehicles. Modernized HMMWVs will be produced to meet Army XXI goals in the following areas:

- Lower overall cost of ownership
- Be affordable to users
- Support Army requirements for information dominance on the modern battlefield
- Leverage and integrate automotive technologies as they mature in the near term
- Support high operational tempos and agility without any increase in O&S costs.

This alternative supports the PM-LTV Life Cycle Management strategy to modernize the HMMWV fleet by leveraging existing commercial technology being developed in the Commercially Based Tactical Truck (COMBATT) program, and developing other improvements to the current HMMWV to improve its utility to the user. Every seven years there will be a planned development period culminating in a series of improvements incorporated into production. These improvements will be block improvement programs to produce a more capable HMMWV. The first set of improvements are described below and will not be a major redesign of the vehicle. Future improvements will be determined based on available technology and the needs of the user community.

General Description: The improved HMMWV will have the model designation "AX" to distinguish it from earlier series. This designation applies only to the AOA and does not affect any HMMWV model designations which are part of the LTV LCM acquisition strategy. The alternative will be represented by the M1097AX for capabilities and technology upgrades. The M1097AX will have all the capabilities of the M1097A2 and satisfy additional requirements of the HMMWV II ORD without significantly redesigning the vehicle. See the attached Vehicle Comparison Matrix for ratings of this alternative against the ORD requirements.

Vehicle Requirements:

Following are HMMWV ORD capabilities which the M1097AX could achieve in the first cycle of improvements and which are improvements to the M1097A2. Meeting these capabilities would not require a major redesign of the vehicle envelope:

- 48 inch water fording
- Traction control
- Positive control of towed load brakes
- Second pintle
- Antilock brakes
- Front end protection
- Door, hatch, fuel filler locks
- Embedded diagnostics
- Basic electrical sockets

- Electrical power in cargo compartment
- 200 amp electrical capacity
- Power Take Off capability
- Fuel access connection
- Night vision device compatibility
- Mounting points for a Crew Compartment Protection Kit
- Removable winch kit
- Gun shield

Alternative 2B
BUY COMMERCIAL VEHICLE

Scope: This alternative procures commercial vehicles to meet light tactical vehicle requirements. As the existing HMMWV fleet reaches the end of its economic useful life, vehicles are replaced by commercial design vehicles. HMMWVs now in the utility, shelter carrier, ambulance, and heavy howitzer towing roles will be replaced by commercial trucks manufactured by a US domestic automobile manufacturer. HMMWVs now in the armament carrier role will be replaced by the RG-31 Nyala, offered by Diesel Division, General Motors of Canada, Limited (DDGM).

General Description: The commercial truck will be represented as a generic domestically manufactured pickup truck with technical upgrades based on planning by the TACOM National Automotive Center for its COMBATT program. The RG-31 description will be based on commercial literature descriptions and technical data provided by DDGM. See the attached Vehicle Comparison Matrix for ratings of this alternative against the ORD requirements.

Vehicle Requirements:

Commercial Truck:

This description covers a family of diesel engine driven, 4 wheel drive light commercial trucks including versions for utility, cargo, ambulance, and shelter carrier. The basic vehicles produced will be produced on the same production lines as those offered to the general public. Military peculiar requirements and performance enhancements will be added to the vehicle by outside "upfitters." All commercial truck types are expected to have a service life of seven years and shall be capable of providing tactical standard mobility required for infrequent off road operations over selected terrain with the preponderance of operations on primary and secondary roads[9]. Following is a summary of the pickup truck configuration:[10]

General	
GVW Rating	9,200 lb.
Payload Kits and Crew	3,270 lb.
Wheelbase	131.5 in.
Cargo Box	97.6 in. x 61.9 in.
Regular Equipment	
Engine	6.5L (395 CID) turbo diesel 195 bhp @ 3400 RPM
Transmission	Heavy duty automatic 4 speed with overdrive
Transfer Case	BW 4401, 2 speed, 2.69 low range
Front Axle	4,250 lb. with center disconnect
Front Stabilizer Bar	1.18 in. diameter

[9] Based on TACOM Purchase Description for Truck; Utility, Cargo and Ambulance, Diesel Engine Driven, 4X4, 17 May 82.

[10] Based on General Motors Military Vehicles Information Sheet on CUCV II Cargo/Troop Carrier, September 1997.

Front Suspension	Heavy duty independent torsion bar, 4,250-lb.
Rear Axle	Full floating, 6,084 lb.
Rear Differential	Automatic locking
Rear Suspension	Semi-elliptical, 2 stage, 6,084 lb. capacity
Axle Ratio	4.10:1
Shock Absorbers	Bilstein heavy duty gas filled
Brakes	4 wheel. antilock, disc front, drum rear
Skid Plates	Under front differential, engine and transfer case
Batteries	Dual 12 volt @ 600 cold cranking amps each
Generator	Delco-Remy, 12 volt, 100 amp
Air Conditioning	Integral with heater/defroster
Cab	Regular. 2 door, 3 passenger
Seat	Full width bench with folding back
Interior Trim	Vinyl seat covers in gray color
Exterior Color	3 color camouflage
Fuel Tank	34 gal. Capacity
Tires	5 LT245/75R16E SBR On/Off Road
Wheels	5 steel disc 16x6.
Rear Window	Sliding, center section
Military Equipment	
Blackout Lighting	Driving, front and rear marker lamps
Brush Guard	Radiator grille
Cargo Cover	Tarpaulin and bows
Cargo Tiedown	4 Rings on each side of cargo bed
Electrical System	12 volt with 24 volt power converter
Slave Start	NATO 24 volt
Tiedown Shackles	Front and rear with rear step bumper
Trailer Tow Hook	Pintle for 3,000 lb. trailer
Trailer Lighting	NATO 12 pin receptacle
Troop Seats	8 Passenger, folding
Weapon Supports	For 2 M16 rifles inside cab
Pioneer Kit	Compact tool kit
Winch	Front mounted 10,000 lb. capacity, electric

RG-31 Nyala:

Diesel Division General Motors of Canada Limited (DDGM) offered the RG-31 Nyala in response to a November 1996 TACOM market survey of manufacturers of light tactical vehicles. DDGM intends to develop a North American version of the RG-31 and is initially offering it to law enforcement markets. The US Army purchased five vehicles for mine blast testing and use in South West Asia.

The RG-31 is available in two landmine-protected versions: a fully enclosed personnel carrier, and as a multipurpose utility platform which has an open rear cargo or weapons platform area. The vehicle was designed specifically for the military and police markets to protect its occupants against a double TM57 level mine explosion under any wheel, a single detonation centrally under the vehicle, and small arms fire up to 5.56 x 45mm armor piercing bullets. Optional protection is available against small arms fire up to 7.62 x 31mm armor piercing bullets. The armor protection is integral to the vehicle structure and is not a kit. The following general descriptions describe the fully enclosed personnel carrier:

Crew	1 Driver plus 10 passengers
Gross Vehicle Weight	18,480 lb.
Curb Weight	13,860 lb.
Payload	4,620 lb.
Length	231.5 in.
Width	90.5 in.
Height	89.4 in.
Ground Clearance	15.75 in.
Wheel Base	133.9 in.
Maximum Road Speed	63 mph
Maximum Longitudinal Slope	60% (Low Range)
Engine	Mercedes Benz OM 366A 6 cylinder in line water cooled turbocharged diesel w/ direct injection, 168 HP @ 2,800 RPM
Transmission	Allison AT-545 4 Speed Automatic
Suspension	Semi-elliptical leaf springs and hydraulic telescopic double-acting telescopic shock absorbers
Steering	Full power
Turning Radius	26.25 ft.
Brakes	Main: pneumatic. Parking: pneumatic release/spring applied
Tires	12.5 x 20 radial, 16 ply
Electrical System	24 volt

Alternative 3
HYBRID REMANUFACTURING

Scope: This alternative conducts a hybrid remanufacturing program to extend the economic useful life of the HMMWV fleet by approximately 50% while simultaneously reducing O&S costs. This alternative is part of the Recapitalization pillar of the PM-LTV Life Cyle Management strategy of using available funds to preserve and enhance past investments. It affords an excellent opportunity for both Modernization Through Spares (MTS) and Horizontal Technology Insertion (HTI).

General Description: For the AOA, these vehicles will have the "A4" model designation. The hybrid remanufacturing program is so titled in order to distinguish it from a complete remanufacture. One of its goals is to return selected high cost drivers to year one O&S costs. The hybrid remanufacturing process will incorporate the following:

- Integrate applique hardware for Army XXI digitization efforts.
- Upgrade power capability (minimum of 100 amp alternator).
- Convert selected existing vehicles to correct imbalances in the fleet model mix.
- Check and apply applicable HMMWV Fleet modification work orders and directed upgrades.
- Inspect and repair body and structure problems.
- Rebuild drive train (engines and transmissions).
- Install new vehicle control unit.

The hybrid remanufacturing program will have a cost ceiling of 50% of the acquisition cost of a new vehicle. Odometers on HMMWV's inducted into this program will not be reset to zero. Selection of vehicles for induction will be based upon a combination of age, mileage, and overall vehicle condition. See the attached Vehicle Comparison Matrix for ratings of this alternative against the ORD requirements.

Vehicle Requirements: Vehicles remanufactured in this alternative will perform at a level not less than that of a M998 HMMWV half-way through its Economic Useful Life and at significantly reduced O&S costs. This alternative extends the Economic Useful Life of inducted HMMWV's by six years with a resultant reduction in maintenance costs of 41%. This is represented in the AOA as a M998A4.

Alternative 4
PROCURE A COMBINATION OF ALTERNATIVES (BASELINE, 2A, 3)

Scope: This alternative procures vehicles through a combination of alternatives. It consists of Alternative 2A, Improved HMMWV (to modernize portions of the fleet); Alternative 3, Hybrid Remanufacturing (to recapitalize the oldest vehicles and preserve investments already made); and continued procurement of new baseline A2 series HMMWVs to fill shortages and maintain a warm production base. This alternative does not involve any vehicle that is not already described in an earlier alternative or in the baseline.

General Description: This alternative, as an Army strategy, has the following objectives and limitations:

Objectives

- Recapitalize on our initial investment in the aging fleet
- Maintain the current fleet through 2010
- Modernize the fleet to focus on Army and Joint Vision goals

Assumptions:

- No "leap ahead" technologies now or in near term render the HMMWV obsolete
- The HMMWV is the basic light tactical vehicle for Army XXI
- No new start or follow-on developmental system is needed until Army After Next
- A stable funding stream is maintained

Vehicle Requirements: Described in previous alternatives.

Alternative 5
PROCURE A COMBINATION OF ALTERNATIVES (BASELINE, 1, 2A)

Scope: This alternative procures vehicles through a combination of alternatives This alternative represents the PM-LTV Life Cycle Management strategy, which consists of Alternative 1, Extended Service Program (to recapitalize the oldest vehicles and preserve investments already made); Alternative 2A, Improved HMMWV (to modernize portions of the fleet), and continued procurement of new baseline A2 series HMMWVs to fill shortages and maintain a warm production base. The Extended Service Program portion of this alternative will include a range of recapitalization activities depending on the condition of individual HMMWVs inducted into the program. This alternative does not involve any vehicle that is not already described in an earlier alternative or in the baseline.

General Description: This alternative, as an Army strategy, has the following objectives and limitations:

Objectives

- Recapitalize on our initial investment in the aging fleet
- Maintain the current fleet through 2010
- Modernize the fleet to focus on Army and Joint Vision goals

Assumptions:

- No "leap ahead" technologies now or in near term render the HMMWV obsolete
- The HMMWV is the basic light tactical vehicle for Army XXI
- No new start or follow-on developmental system is needed until Army After Next
- A stable funding stream is maintained

Vehicle Requirements: Described in previous alternatives.

Excursion 1
PROCURE AN EXISTING ARMY VEHICLE

Scope: This alternative procures vehicles which are already in the Army fleet for other roles and uses them to fill some light tactical vehicle roles now filled by the HMMWV. As the HMMWV fleet ages, vehicles in the shelter carrier roles would be replaced by the M1078 Light Medium Tactical Vehicle (LMTV). HMMWVs in the armament carrier role would be replaced by the XM1117 Armored Security Vehicle (ASV).

General Description: The LMTV is the light version of the Family of Medium Tactical Vehicles (FMTV) which consists of light and medium vehicles, including trailers. It covers a family of diesel engine driven, automatic shift transmission, radial tired, all wheel drive trucks. The XM1117 ASV is a Non-Developmental Item (NDI) acquisition program. It is a turreted, lightly armored all wheel drive vehicle that provides ballistic protection to the crew compartment, weapons station and ammunition storage area; overhead protection; and protection against anti-personnel mines and anti-tank mines. See the attached Vehicle Comparison Matrix for ratings of this alternative against the ORD requirements.

Vehicle Requirements:

M1078 LMTV:

The LMTV accommodates a 5,000 lb. payload and a 7,500 lb. towed load. The Medium tactical Vehicle (MTV) transports a 10,000 lb. payload and a 21,000 lb. towed load. These vehicles operate under on road/off road conditions and withstand the strain, shocks, vibrations and other detrimental conditions incident to off road travel and operation. The LMTV carries a three soldier crew[11].

XM1117 ASV:

The ASV will be transportable (roll-on/roll-off) by C-130 and larger aircraft, rail and marine transport modes. The ASV will carry 4 persons equipped with a turreted primary weapons station which includes a day/night target acquisition and fire control system for US Army Military Police Corps. The ASV will utilize weapons such as the MK19 Grenade Machine Gun; M-2 .50 caliber machine gun; M-60 7.62mm machine gun; and M249 5.56mm Squad Automatic Weapon. The ASV, with all kits installed, will accommodate a payload of 3,360 lb. The ASV will operate on standard Army diesel fuels and JP8; be capable of being towed, performing self-recovery, recovering equivalent vehicles, and mounting a tow pintle rated at 500 lbs. It will accept current tactical radio systems with appropriate encryption equipment. These vehicles will operate under on-road/off-road conditions and withstand the strain, shocks, vibrations and other detrimental conditions incident to off-road travel and operation[12].

[11] FMTV System Specification, 17 Dec 96.
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